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OIMT-CORR 13.0050

MEMORANDUM

March 15, 2013

To: Department Directors, Deputy Directors, and Chief Information Officers

From: Sanjeev "Sonny" Bhagowalia
Chief Information Officer

Subject: Completion of the Shared Data Center Assessment and Strategy Project Report

The Office of Information Management and Technology (OIMT) is pleased to announce that the State has reached another major milestone in the planning and implementation of the Business and IT/IRM Transformation Plan. In February 2013, OIMT completed the Data Center Assessment and Strategy Report.

The assessment report clearly identifies existing vulnerabilities, risks, and areas of opportunity to mitigate exposure by outlining a plan for consolidation and concentration of the State's IT resources into a multi-center, highly scalable, robust, secure, and stable configuration. In addition, the report clearly outlines a strategy for moving forward and maintaining the momentum needed for success over the course of the entire transformation effort as it relates to Data Centers.

From the assessment report, we can now develop a fully detailed road map for the future that outlines the states computing, storage and networking strategy. This roadmap will enable the State to deliver improved and transparent government services across the multiple physical data centers, while establishing a solid security posture that will keep State government data and information safe and secure. The report further highlights areas of collaboration, partnerships and synergies between the State of Hawaii, our county partners and federal government agencies looking to also establish a presence here in our island state.

A redacted version report can now be viewed at the OIMT website located at: http://oimt.hawaii.gov/. Departments may request a copy of the unredacted report; all requestors will be asked to adhere to non-disclosure of the unredacted report.

Your input, ideas, and collaboration have made this final assessment report possible and we thank you for your continued support in helping to transform our Hawaii towards a New Day!

Data Center Assessment and Strategy

Alternatives Analysis, Strategic Data Center Recommendations and Migration Plan
PUBLIC VERSION

Prepared for

12 March 2013

GARTNER CONSULTING
Engagement: **330011782** Version #1

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Executive Summary

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Executive Summary

- To enable the transformation of government as envisioned in Governor Abercrombie's New Day Plan and OIMT's Business and IT/IRM Transformation Strategic Plan, the State of Hawaii needs a secure, robust, resilient environment for the State's current and emerging applications. Providing consistent, reliable access to State services, especially when disaster strikes, is essential to restoring citizen confidence in government.
- The State's decentralized data centers, many lacking basic features such as adequate security, cooling, generators and protection from flooding, expose the State to a potential shut down of services for weeks or months due to a major Honolulu-centered disaster. New State-wide applications and critical Departmental applications are not secure in this environment, putting at risk the State's investments and assets, and impacting citizens who rely on the State for fundamental needs.
- To provide the robust environment needed to reduce risk and enable transformation, the State should:

Construct a modern Tier 3 primary data center at an interior location on Oahu to ultimately house all of the State's primary IT assets.

- Minimum of10,000 square foot computer room
- 1.5 -2.0 megawatts of IT equipment capacity
- Space for 75-100 operational personnel
- Modular architecture to minimize initial investment and "overbuilding" risk
- Efficient, green facility with a smaller environmental footprint than today's distributed data centers

Refurbish the ICSD data center in the Kalanimoku Building and repurpose it as the State's interim Disaster Recovery center.

Create a State data center presence on Hawaii, Maui and Kauai through partnerships with the Counties and establishment of secure State-controlled environments within modern County-owned data center facilities. Provide Counties with space in the new State data center for off-island disaster recovery.

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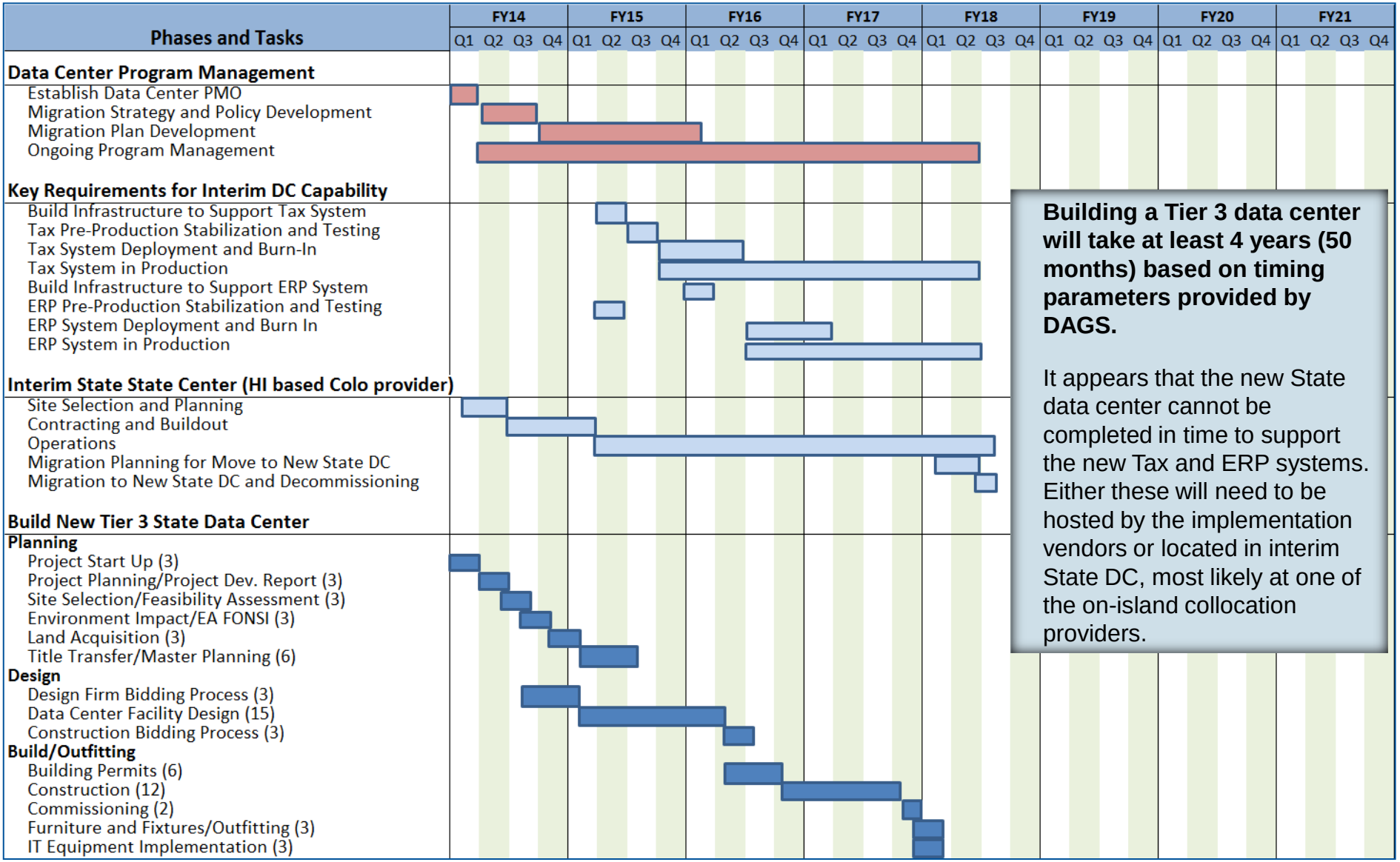
Executive Summary
Migration Timeline



Building a Tier 3 data center will take at least 4 years (50 months) based on timing parameters provided by DAGS.

It appears that the new State data center cannot be completed in time to support the new Tax and ERP systems. Either these will need to be hosted by the implementation vendors or located in interim State DC, most likely at one of the on-island collocation providers.

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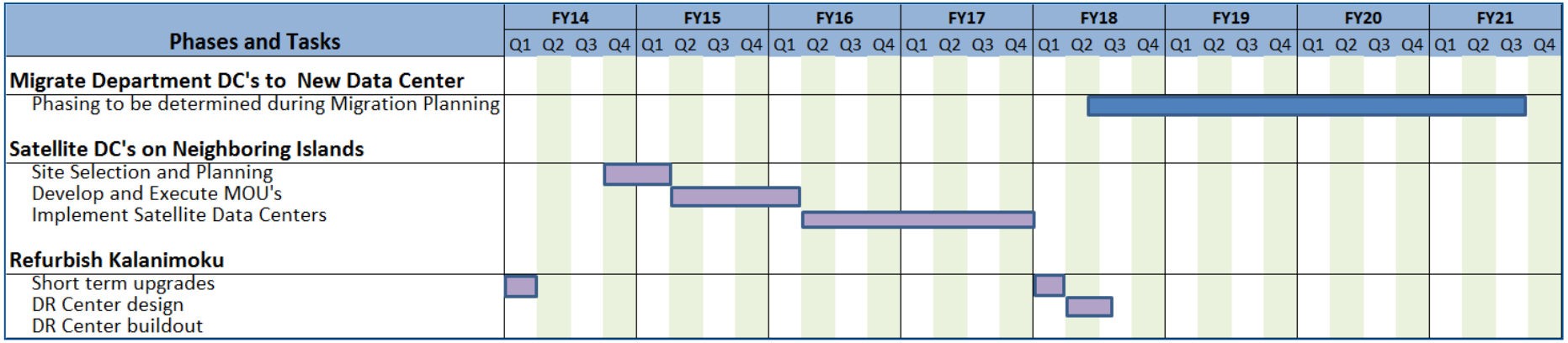
Executive Summary
Migration Timeline (continued)



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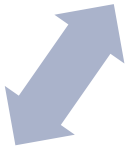
Key Elements of the State's Data Center Project – Scope, Budget and Schedule

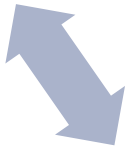
Scope

Construct a modern Tier 3 primary data center at an interior location on Oahu to ultimately house all of the State's primary IT assets.

Refurbish the ICSD data center in the Kalanimoku Building and repurpose it as the State's interim Disaster Recovery center.

Create a State data center presence on Hawaii, Maui and Kauai through partnerships with the Counties and establishment of secure State-controlled environments within modern County-owned data center facilities. Provide Counties with space in the new State data center for off-island disaster recovery.





Budget

Substantial investment required

Schedule

~ 4 years (50 months) to complete construction of new primary data center

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Summary Report

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Part 1: Case for Change

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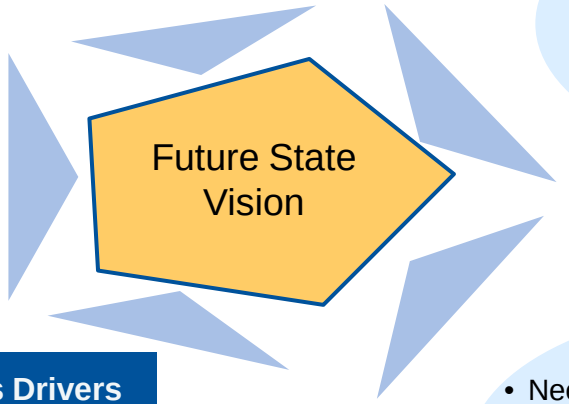
Key Drivers for the Future State Vision

The development of the future state vision was driven by a consideration many critical factors.



Risk Exposure

- Major Honolulu centered disaster could shut State IT down for weeks or months
- DC's not secured or monitored on 7x24x365 basis
- Major power outages will significantly impact State IT Operations

Current Environment

- 26+ inadequate dept./div. DC's
- Critical State applications housed in an end of life Tier 2 data center (ICSD)
- No DR site for most critical state applications
- Most DC's lack generators, security, monitoring & expansion capability

Technology Drivers

- Data Center Consolidation
- Virtualization & Private Cloud
- Modular Data Center Construction
- Cloud Computing

Business Drivers

- New ERP & Tax Systems being procured
- More new mission critical system describe in the State's IT Strategy
- 7x24x365 web presence required, that is secure and linked to backend systems to enable public access to data and transactions.
- New systems will drive higher workforce dependence on systems; extended downtime will not be tolerable

Political Economic Factors

- Need to invest in and create jobs in Hawaii
- Preference for Bond funding vs. General Fund funding
- Strong desire to leverage and improve existing state assets where possible
- Tight operating budgets continuing for the next 5 years

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Current Environment

Current state data centers are not aligned with best practices and expose the State to major risks.

Current Environment

- 26+ inadequate dept./div. DC's
- Critical State applications housed in an end of life Tier 2 data center (ICSD)
- No DR site for most critical state applications
- Most DC's lack generators, security, monitoring & expansion capability

Critical Facts

- 49,000+ employees rely on the State's IT systems
- 2 Mainframes
- 2300+ Physical Servers
- 4000+ Logical Servers
- 650+ Terabytes of data

Key Observations

- Most of the dept data centers :
  - Are 500 sq. feet or less with little expansion capability
  - Are staffed by 2-3 FTE's, who lack critical skills and focus
  - Are monitored/staffed during bus. hours
  - Lack generators, redundant power and cooling and DC class fire protection
  - Are located in Honolulu office buildings, typically on lower floors
  - Set/follow inconsistent hw/sw standards
- The ICSD data center (Kalanimoku)
  - Is an aging facility with many components requiring refurbishment
  - Located close to shore in basement
  - Lacks redundant power and cooling
  - Lacks DC class cooling systems and power distribution
  - Has antiquated fire suppression
  - Has poorly maintained physical plant, resulting in cooling and maint. issues
  - Is messy, disorganized and difficult to secure due to co-location with people, printing plant and other non DC functions.
- UH is building a 1.2MW Tier 2 facility and DOE is building a new server room in a decommissioned school

Strategy Implications

- Existing state data centers are not well aligned with best practices
- Upgrading or expanding departmental data centers is not practical
- Kalanimoku requires significant upgrades and improvements to remain the state's primary data center
- Most state data centers could be impacted by a major Honolulu centered disaster event
- Planned new DOE and UH DC facilities lack the long term capacity and redundancy required by the state for a primary data center

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Risk Exposure

A major Honolulu-centered disaster could shut the State's IT system down for weeks or months.

Risk Exposure

- Major Honolulu centered disaster could shut State IT down for weeks or months
- DC's not secured or monitored on 7x24x365 basis
- Major power outages will significantly impact State IT Operations

Critical Facts

- Most DC's located in or near downtown Honolulu
- No designated and equipped disaster recovery site
- Tactical plans by some departments to use Honolulu - based collocation providers as DR sties ignore the fact that these providers could be impacted by the same disaster event as most State Data centers

Key Observations

- Most State data centers are located in or near downtown Honolulu near the shoreline.
- Most are located on the first floor or basements of standard office buildings.
- While some departments have COOP plans in place, most lack IT disaster recovery plans and where such plans do exist, required infrastructure (e.g. DR facilities and equipment) have not been funded.
- The current decentralized data center strategy lacks 7x24x365 monitoring, staffing and security at most facilities.
- The state relies entirely on mostly manual tape backup systems for DR protection.
- A separate security assessment has pointed out that the current distributed DC infrastructure complicates the ability of the State to secure its critical systems and data from cyber attack.

Strategy Implications

- A major Honolulu based disaster event could shut the state's IT systems down for weeks or months.
- For modern systems, tape backup needs to be coupled with offsite data replication to ensure DR recovery objectives are met.
- There is a significant risk that some data could be permanently lost in a disaster.
- 7x24x365 monitoring and physical security is prohibitively expensive in decentralized data center environments. This does not mean it is not required.

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Business Drivers

The types of systems envisioned by the State's IT strategy cannot be supported by the current DC's.

Business Drivers

- New ERP & Tax Systems being procured
- More new mission critical system describe in the State's IT Strategy
- 7x24x365 web presence required, that is secure and linked to backend systems to enable public access to data and transactions.
- New systems will drive higher workforce dependence on systems; extended downtime will not be tolerable

Critical Facts

- Tolerance for downtime of enterprise systems will be much lower than the departmental system they replace
- ERP and Tax systems will require robust DR capabilities
- Web enabling core systems for public access with require robust enterprise security and integration capabilities

Key Observations

- The state is currently planning to implement a statewide ERP system which will replace many existing departmental systems and functions.
- The state is also planning to implement a new tax system.
- The long-term strategies of the state call for the implementation of many other critical systems to replace antiquated systems and partially or fully manual business processes.
- In addition, the state plans to make many state systems accessible to the public via the Internet (e.g. pay taxes, register vehicles, pay fines, apply for permits, etc.)
- All of these plans are well aligned with actions that most mainland state governments have already taken.
- Most other state governments have found that the combination new systems, more integrated systems and publicly accessible systems have create new demands on the underlying systems and data center infrastructure for 7x24x365 availability and made previously tolerable outage windows and disaster risks intolerable.

Strategy Implications

- The maturity/sophistication of Hawaii's current IT systems less than that of other states
- The State's IT strategy is a roadmap for Hawaii to rapidly catch up by modernizing or deploying new systems.
- New requirements for continuous availability will drive the need for 7x24x365 data center staffing and for more robust DC's that do not require downtime and are not subject to extended outages.
- New and existing systems will need to be secured against cyber threats
- New DR capabilities that can meet the stated recovery objectives will also be required
- The cost of meeting these requirements in a distributed DC environment will be prohibitive.

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Technology Drivers

Key technology trends will help the State modernize its data center faster and more cost effectively.

Technology and Drivers

- Data Center Consolidation
- Virtualization & Private Cloud
- Modular Data Center Construction
- Cloud Computing

Critical Facts

- Data center consolidation is a best practice
- Server virtualization is mature and should be considered a mandatory practices
- Data centers can be built in “pods” as capacity is needed
- Cloud computing is an alternative for some applications

Key Observations

- Most States no longer house key systems in decentralized server rooms.
- Most states, including California, Michigan and Texas, have established enterprise level data centers and DR centers.
- Federal government is also consolidating. Federal Data Center Consolidation Initiative (FDCCI) is intended to reduce space, improve power usage effectiveness, and decrease total energy use.
- Most new state-wide DC builds have been Tier 3 facilities which can provide continuous availability and protection from extended outages.
- DR facilities are usually Tier 2 or 3. The old DC is often repurposed for DR
- Industrial scale, standardized server virtualization can reduce DC capacity needs by 60% or more.
- Automation and virtualization can reduce system provisioning times from weeks or months to days or hours.
- Modular DC design can reduce initial investment costs by allow capacity to be built out only as it is needed.
- The SaaS model of cloud computing can be very attractive for many types of applications.

Strategy Implications

- The state’s long term strategy should be to eliminate departmental data centers through system attrition and consolidation
- As new systems are implemented or moved to a centralized data center they should be migrated to a standardized and virtualized server and storage platform
- Any new data center should employ a modular, scalable architecture which will allow the State to build out new capacity as it is needed
- The State should consider cloud deployment options (using the SaaS model) for applications where customization and internal hosting are not critical.

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Economic and Political Drivers

There is significant competition for scare general fund resources; bond funding is more accessible.

Political and Economic Factors

- Need to invest in and create jobs in Hawaii
- Preference for Bond funding vs. General Fund funding
- Strong desire to leverage and improve existing state assets where possible
- Tight operating budgets continuing for the next 5 years

Critical Facts

- The economic climate in the state is improving but is not good.
- No matter how critical, a large investment in data center will be scrutinized against other underfunded priorities (education, pensions, healthcare, police)

Key Observations

- The Governor and other State leaders prefer solutions which result in State spending stimulating the local economy.
- There is strong public support for this policy. The construction of a new DC in Hawaii would visibly demonstrate this commitment.
- While operating funds continue to be stretched, the State's high credit rating and low interest rates has made substantial bond funding available to the State.
- The Governor and other leaders have spoken out against "bad investing" which involves the use of bond funding to support program operations and "good investing" which involve new roads, emergency equipment, building and other infrastructure which the state can leverage in the future.
- Before new investments are made, the state must carefully consider how existing assets could be improved or optimized to achieve the same purpose.

Strategy Implications

- Options for renting or leasing data center space may not be favored by the State due to tight general fund budgets.
- Investing in a new Hawaii data center that creates construction and high tech jobs is aligned with the "Hawaii First" strategy.
- Investing in a new Hawaii data center with a 20-30 year expected life is likely to be viewed as a "good investment" of borrowed funds given the State's needs and current risk exposure.
- A solution which involves leveraging and optimizing existing assets in order to defer large investments to the future will be preferred in many circumstances

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The State's investment in a new data center on Oahu, and additional investments in the neighbor islands will have a positive economic impact on the State of Hawaii

- **The State's investment in building a new data center will fuel approximately $21M in construction jobs in the short term.**
  - A substantial portion of the cost of data center construction is labor. The State's investment in construction of the new data center will result in approximately $21M for labor.
  - If we assume that each construction job (fully burdened with taxes, benefits, and profit margin) costs $150,000 - $200,000 annually, the $21M labor investment results in an average of 120 man years of labor (e.g., 120 jobs for 1 year, 30 jobs for 4 years).
- **The State's investment will prevent jobs from shifting from Hawaii to the Mainland, with a 10-year positive economic impact of approximately $55M to the State.**
  - Without a secure, robust, resilient data center, State Departments will likely host new systems with co-location vendors, many of whom are on the Mainland.
  - We assume that, due to this consistent increase in outsourcing, the equivalent of 50-100 IT jobs could shift from Hawaii to the Mainland. At approximately $75,000 in salary per year, that is an average of $5.5M per year in lost wages in Hawaii. Over 10 years, that's an economic impact of $55M.

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The State's data center strategy and investments are aligned with the Hawaii Broadband Initiative

- **Access to State services is a key contributor to broadband adoption.** The State's strategy calls for more services to be available to the public over the internet within 5-7 years.
- The State's on-line services must be provided securely and reliably to customers, and that is done through a robust, resilient, secure data center.

Hawaii Broadband Initiative

- Using the Almqvist model of 80 new jobs for every 1,000 new broadband connections, O'ahu could gain approximately 3,376 new jobs, and Island of Hawai'i could gain 720
- Using the Almqvist statistics of gross domestic product (GDP) growth of 1% for every 10% in broadband penetration, the State GDP could rise 1.15% (51,000 new broadband connections/440,000 Internet users in Hawai'i without broadband)
- 1.15% GDP growth equates to $805 million in new revenue and approx. 4,100 new jobs could drop the unemployment rate in the State to 5.5%

Source: Hawaii Broadband Initiative Report excerpts

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Part 2: Future State Vision

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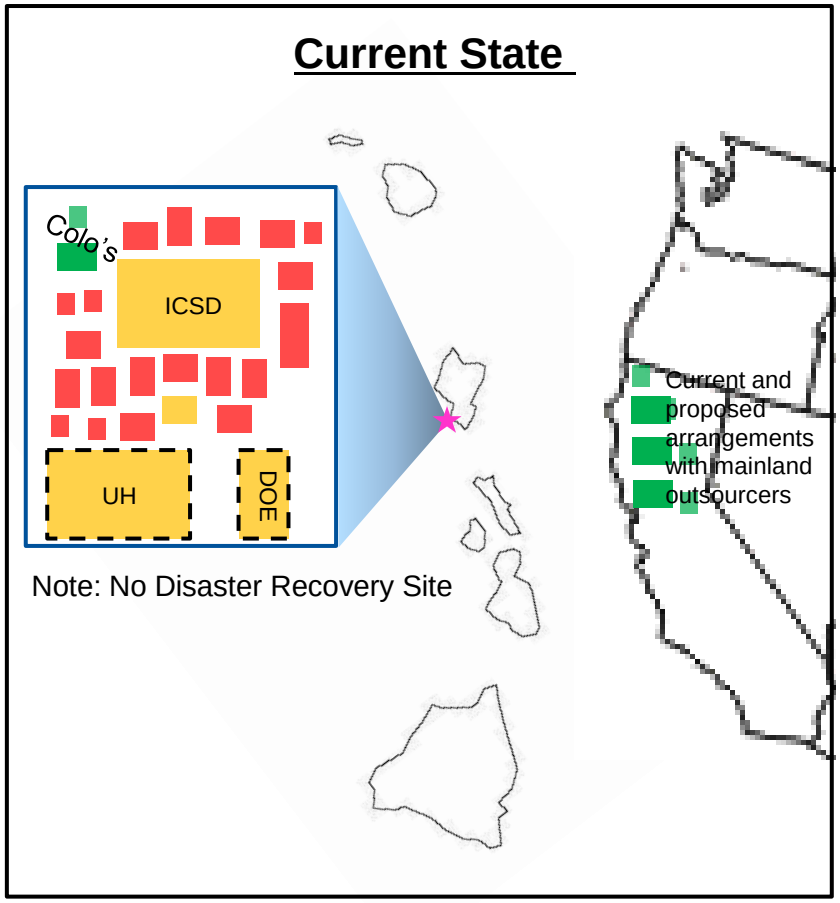
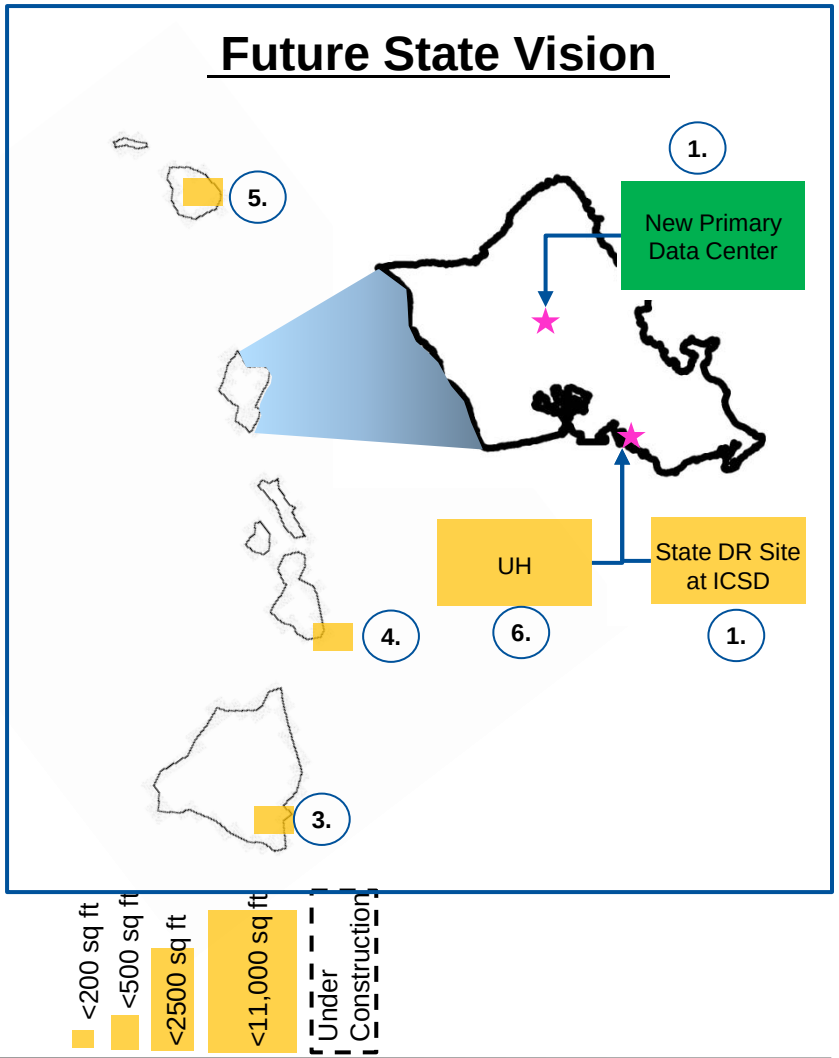
Future State Vision: Next 5-10 years

The State will close most existing departmental data centers and collocation cages and migrate primary IT workloads to a new Tier 3 data center in central Oahu. The current ICSD data center will become a DR facility. In partnership with local governments the State will establish "caged" environments on the NI's.





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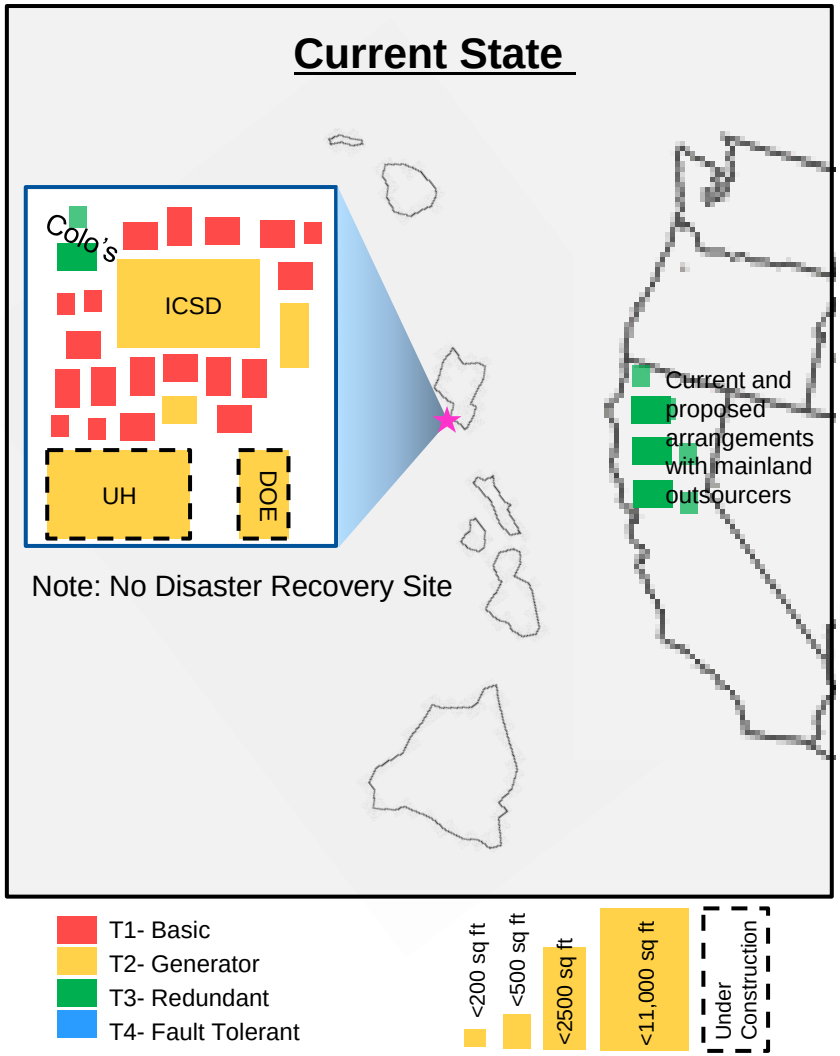
Future State Vision: Next 5-10 years

The Future State Vision will address problems, risks and limitation inherent in the current state



Key Risks and Limitations Addressed

- Current security and disaster recovery risks are addressed in four principle ways
  - Existing IT workloads will be moved from over 26 different server rooms and closets to a single DC and managed to a common set of standards and practices
  - The new DC will be constructed to Tier 3 standards with redundant generators, power systems and cooling systems.
  - The new DC will be staffed and secured 7x24x365, something not affordable across 26+sites.
  - The new data center will be in in a less disaster prone location away from Honolulu and the coast.
    - *While no location has been selected, Mililani Technology Park has been identified as an example location with the needed attributes.*
- The new Data Center will be built using modular techniques which will allow the State to increase its capacity over time as needs increase or change
- In the short term (next 5-7 years), the existing ICSD Kalanimoku data center will be used as DR site. Longer term this may move to UH, a collocation provider or a new facility .

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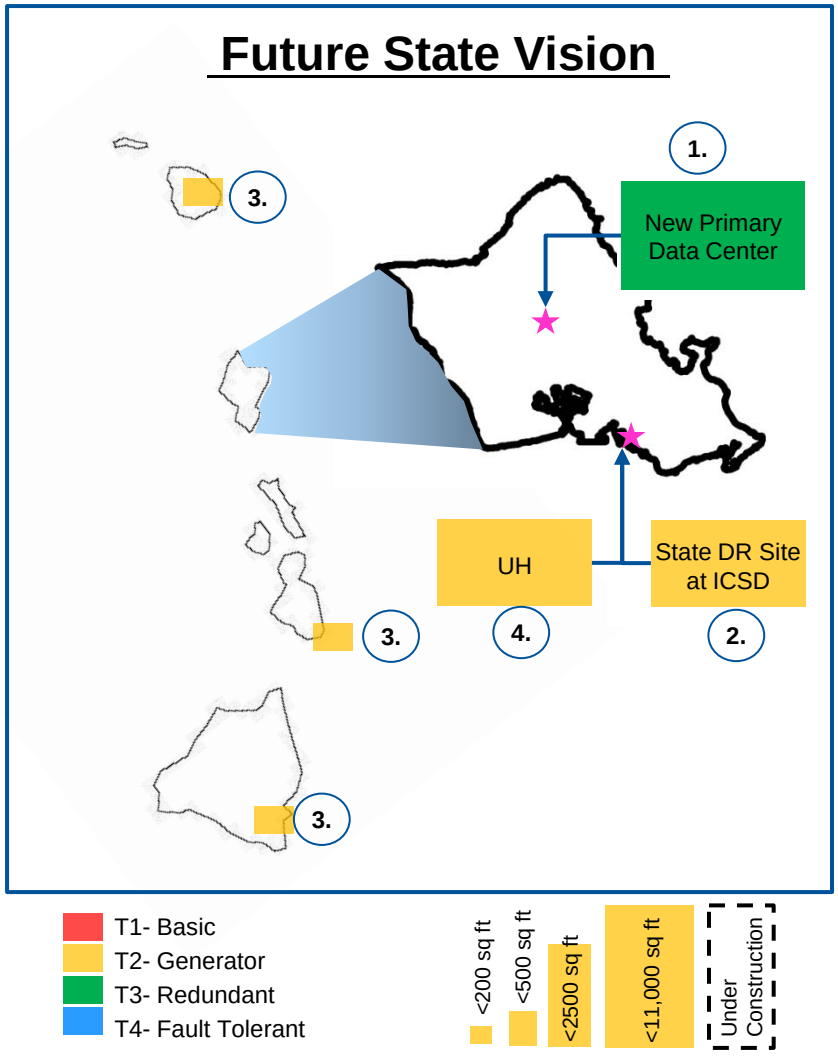
Future State Vision: Next 5-10 years

The Future State vision creates a solid and cost effective computing platform that the State will be able to leverage to mitigate current challenges and risks, and provides a solid foundation for realizing the goals of the State's ambitious IT Strategy.

Key Aspects of the Future State Vision

1. The State will construct a modern Tier 3 data center in a less disaster prone area on Oahu.
   - Minimum 10,000 sq. ft. computer room
   - 1.5 -2.0 megawatts of IT equipment capacity
   - Space for 75-100 operational personnel
   - Modular architecture to minimize initial investment and "overbuilding" risk
   - This facility will eventually house all of the state's primary IT assets (server, mainframe and storage)
   - It will be an efficient, green facility with a smaller environmental footprint than today's distributed DC's.
2. The existing ICSD Kalanimoku data center will be lightly refurbished and repurposed as the State's interim Disaster Recovery center.
3. The State will work with County governments on the NI's to establish State controlled and secured "caged" environments with County owned data center facilities.
   - This strategy will allow both Governments to stretch their Data Center investment dollars and could server a model for other IT collaborations in the future



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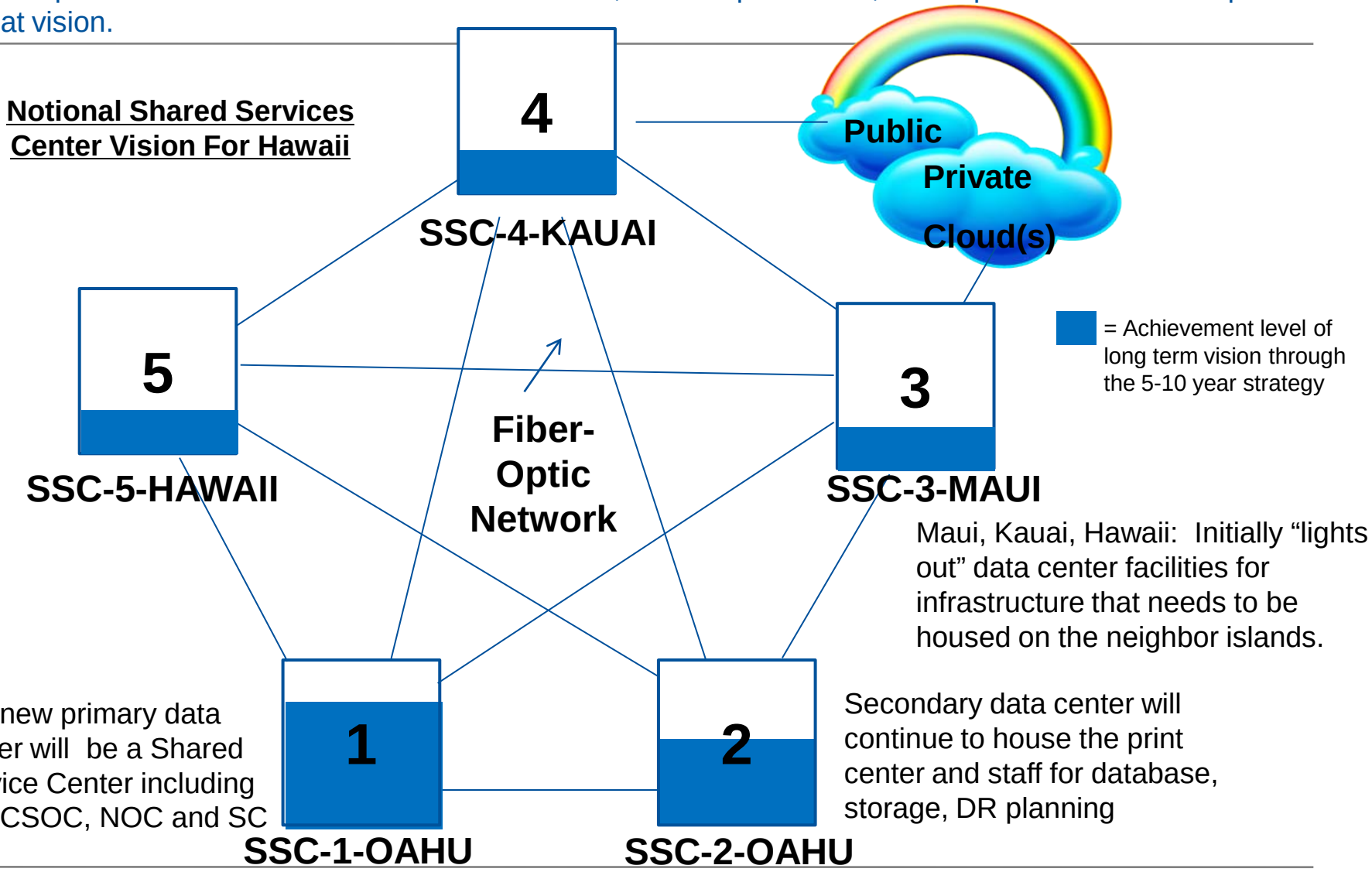
Future State Vision: 10 years and beyond

The State's longer term vision includes a broader shared services center approach. The strategy defined in this report is consistent with this overall vision and, when implemented, will help the State achieve parts of that vision.



Shared Service Center (SSC) = Data Center (DC) + Cyber Security Operations Center (CSOC) + Network Operations Center (NOC) + Services Center (SC)

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Future State Vision: Other Options

A number of potential data center solution alternatives (to building and owning data centers) were considered, however each has significant and unacceptable risks related to timing and financing. If these risks can be resolved, these options could considered for any of the State's data centers.

- **Federal Government Renewable Energy Data Center**
  - The Federal Government is undertaking a feasibility study to determine the commercial viability of building a new data center facility in the State that is powered by renewable energy. The goal of this facility is to improve information security through energy security.
  - The hypothesis being tested is for a large data center complex, up to 20MW, to be built with private funding, leased to Federal Government agencies and other agencies under long-term lease agreements, including the State and commercial entities. The data center complex would be powered using a renewable energy plant to be constructed adjacent to the complex.
  - A long term lease arrangement would require that the State use operating funds. There may be other ways to participate that would allow the State to use bond funds. Those possibilities should be more fully explored as the Federal project progresses.
  - The Federal Government would like to achieve some "early wins" in the 2015/2016 timeframe. As the study is only in the feasibility stage, early wins have yet to be defined but could take different forms. An early win could be just identifying the site for the new data center, or it could be breaking ground, or having something operational.
  - **The State should continue to communicate with the Federal Project Team to explore opportunities to partner as the project continues through the planning stages.**
- **Department of Defense Emergency Operations Center**
  - The Department of Defense (DOD) is in the early planning stages of a new Emergency Operations Center. This would be used by State Civil Defense and potentially other agencies.
  - **The State should continue to communicate with the DOD Project Team to explore opportunities to partner as the project continues through the planning stages.**

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Future State Vision: Other Sourcing Options

A The data center strategic analysis considered two alternative methods of sourcing the primary data center which have the potential to deliver required data center capabilities up to 2 years earlier than the recommended solution.

- **Public Private Partnership – Turnkey Data Center Lease**
  - The data center strategic analysis considered an approach in which the State would contract with a Turnkey Data Center Provider to build a data center for exclusive use of the State. In this scenario, the State would enter into a 7-15 year lease of the data center facility and thereby avoid the upfront capital expenditures as well as the complexity of acquiring land, permits, approvals and managing a construction project.
  - Examples of potential public private partnership partners include: Commercial data center developers/REITs, critical facility construction firms, data center service providers, colocation providers, and cloud service providers.
  - This approach was rejected largely because of the State's desire to fund as much of the new data center construction through capital (e.g., bond) funding. The data center strategic analysis clearly showed that this approach could be implemented 1-3 years faster than the recommended State-managed build process.
  - **If the State's strong preference for bond funding changes, then the Public Private Partnership – Turnkey Data Center Lease becomes a viable option.**
- **Public Private Partnership – Turnkey Data Center Build**
  - Another option for acquiring a data center would be to contract with a third party data center construction firm or turnkey data center leasing firm to acquire land, build a turnkey data center on that land and then sell the completed asset to the State. While this is not a common practice, inquiries with key Data Center Turnkey Lease providers indicate that this is a service that is provided.
  - While the data center strategic analysis did not consider this option in detail, it appears that this sourcing option could be implemented 1-3 years faster than the recommended State-managed build process.
  - **As the State decides on the process it wants to follow to build the new data center (typically: bid-design-bid-build or bid-design-build), it may wish to also consider a bid-turnkey-design-build option as well.**

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Key questions to be answered by the Data Center Future State Vision

Hawaii will strategically leverage existing publicly-owned and commercial data center facilities while building a new Tier 3 center to realize the goals of the State's ambitious IT Strategy.

A. **What types of data centers does the State require?**

B. How many data centers does the State require?

C. How large and robust does each data center need to be?

D. Where should the data centers be located?

E. How should the data centers be sourced (build, leased retrofitted, rented or cloud)?

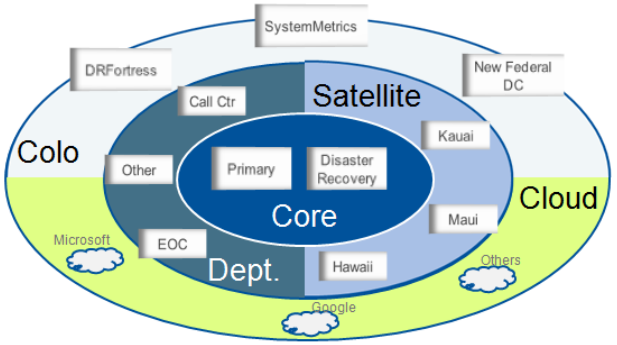
F. What core services should the new data center provide?

G. How much will the future state vision cost?

H. When can the new data centers be operational?

Five Types of State Data Centers

1. Core
2. Satellite
3. Departmental
4. Co-location
5. Cloud



Rationale

- Most of the State's critical IT assets will be consolidated to a number of **Core** state data centers. This will allow the State mitigate key risks around disaster exposure, 7x24x365 operations, understaffing and skill development/retention.
- The State will establish cross-departmental **Satellite** DC facilities on neighboring islands to support special performance and COOP needs.
- **Departmental** server rooms will continue to be permitted where justified by critical business requirements
- On-Island **Colo** providers will continue to be leveraged for temporary or shorter term needs
- Some applications may be sourced from the **cloud** (e.g. SaaS) and may never touch a State DC

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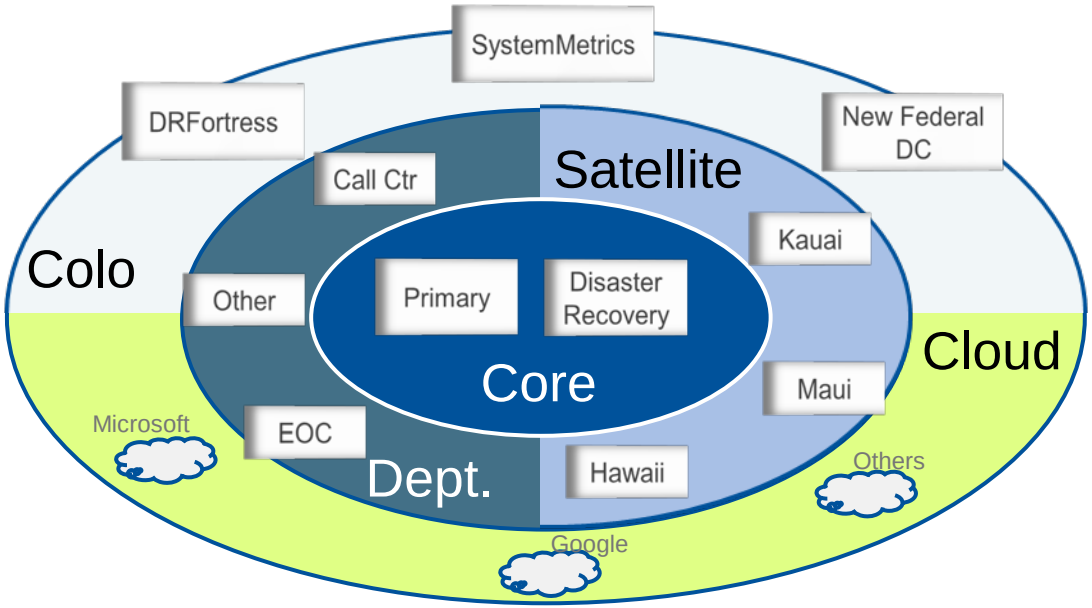
A. What types of data centers does the State require?

The proposed Future State Vision is an “all of the above strategy” which focuses on putting most assets into two Core data centers but allows for other types to be used based on business requirements and special circumstances.

Five Types of State Data Centers

1. Core
2. Satellite
3. Departmental
4. Co-location
5. Cloud



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A. What types of data centers does the State require?

While the State will leverage 6 types of Data Centers, 75-85% of State IT assets (server, storage, data) will be contained in the two Core state owned and operated facilities.

	Core- Primary	Core- Disaster Recovery	Satellite	Departmental	Cloud	Co-location
Exists Today?	No	No	No	Yes	No	Yes
Examples	New Tier 3 Data Center called for in the Future State Vision	Repurposed ISCS Data Center envisioned in the Future State Vision	Secure and State Controlled "Caged" Environments envisioned in the Future State Vision	Server rooms supporting equipment which for performance or COOP reasons must be validated	Software as a Service provider's data center located on the mainland	Island based commercial data center service providers
General Location	Oahu	Oahu or Neighboring Island	New State Data Center on Neighboring Island	Server rooms co-located with new or existing critical state operations	Amazon, Microsoft, Google, Oracle or Workday data centers located on the mainland	Systemmetrics, DRFortress
Example Locations	Mililani Technology Park Other sites with similar attributes	ICSD Kalanimoku data center Co-lo Provider on Oahu New State data center in Honolulu New State data center on NI Existing State or County DC on NI	West Hawaii Civic Center EOC/DC Waikapu Quarry-	Server room in the State's Emergency Operations Center	Mainland	Existing Facilities near Honolulu
Contents	Contains all enterprise level State IT assets and all departmental assets that do not have a business justification for being housed in a satellite, departmental, co-location or cloud data center	Contains servers and storage arrays intended to allow continuity of operations if the Primary Core data center or one of the Satellite data centers fails. Some of this equipment may be used for test, QA or development purposes	Contains servers and storage arrays which due to performance or continuity of operations (COOP) requirements must be housed on a neighboring island.	In general, departmental server rooms will be decommissioned and discontinued. Exceptions will be allowed only for equipment where co-location with end users is critical. This might include telephony equipment required to support a call center or special server room to house communication and dispatch systems for an emergency services organization. Departmental server rooms may also be used to house not production	Cloud data centers will typically be located on the mainland and will be used to house applications which the state acquires via a cloud (or SaaS) model. For example, the State may contract a provider such as Google or Microsoft to provide email and calendaring services for all State employees.	Island based co-location providers, such as SystemMetrics and DR Fortress may be used to provide temporary data center capacity while State Data Centers are being built or expanded. They may also provide a good location for temporary equipment which is only needed for a limited amount of time, such a development servers for a short-duration project.

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A. What types of data centers does the State require? (continued)

	Core- Primary	Core- Disaster Recovery	Satellite	Departmental	Cloud	Co-location
Control & Management	State IMD Staff	State IMD Staff	State IMD Staff with support from County IT facilities staff	Departmental IT Staff	Cloud Provider Staff	State IMD or Departmental IT Staff assisted by Service Provider Staff
Robustness	Tier 3	Tier 2 (minimum)	Tier 2 (minimum)	Tier 2 (minimum)	Tier 3 or 4 as required to support defined SLA's	Tier 3 or 4 as required to support defined SLA's
Staffing & Security	7x24 Security and Operational Staffing	Business Day staffing except during a declared disaster or readiness test	Business hours support unless requirement dictate otherwise	Departmental discretion, but likely business hours support	7x24 Security and Operational Staffing	7x24 Security and Operational Staffing
Expected Distribution of Current State IT Assets	***80%+***	***5%+ but growing as DR plans are funded and implemented***	***<5%***	***<5%***	***<5% but possibly growing as more departments adoption cloud based (e.g. SaaS) based solutions***	***<5% mostly limited to temporary infrastructure require to support large programs or projects***

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Key questions to be answered by the Data Center Future State Vision

A careful analysis of all of the requirements indicates a 5 data center strategy is optimal.

A. What types of data centers does the State require?

B. **How many data centers does the State require?**

C. How large and robust does each data center need to be?

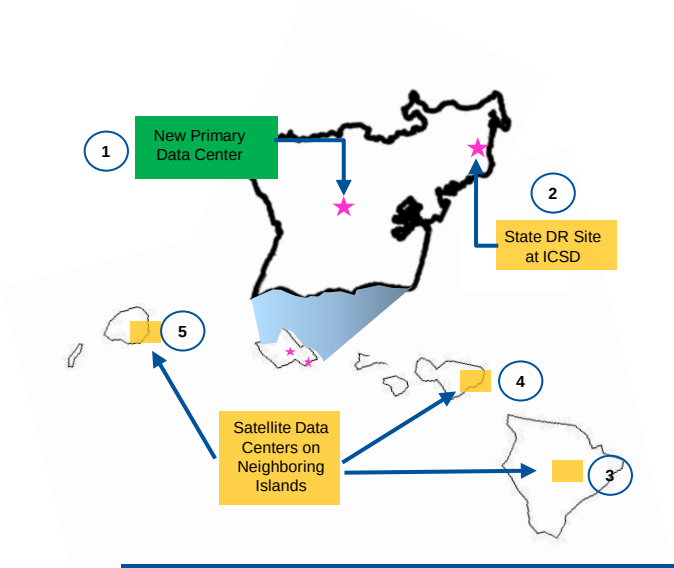
D. Where should the data centers be located?

E. How should the data centers be sourced (build, leased retrofitted, rented or cloud)?

F. What core services should the new data center provide?

G. How much will the future state vision cost?

H. When can the new data centers be operational?



Rationale

- The Five data center strategy proposed in the State's IT strategy continues to make sense
- Two core data center will contain 75-85%+ of the State's IT Assets
  - One will be designated as primary the other for disaster recovery
- Satellite data centers will be established to provide locally delivered services on the neighboring islands

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B. How many data centers does the State require?

Two core data centers are required to support the State availability and recovery requirements. More than two core data center cannot be justified due to high acquisition and operational costs.

Summary of Gartner Alternatives Analysis – Number of Core Data Centers

	Alternative 1 One Primary Data Center	Alternative 2 Two Data Centers	Alternative 3 Multiple Core Data Centers
Overall Score	183	308	232
Ranking	3	1	2
Screen	FAIL	Pass	Pass
SUMMARY	Unacceptable level of risk for long term disruption of service if the single primary data center is incapacitated.	Meets availability, reliability and disaster recovery needs at lower cost, complexity and risk than multiple core DCs. Leading practice.	Overbuilds for State requirements, adding complexity, risk and significant cost.

To understand the detailed analysis, see appendix materials at the end of this report

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B. How many data centers does the State require?

Based on the type of applications that the State currently utilizes and its current deployment plans, an Active/Standby configuration for the two core data centers is appropriate. Active-Active is not required by any current or planned applications and would be significantly more expensive to build and operate.

Summary of Gartner Alternatives Analysis – Active vs. Hot/Warm/Cold Standby

	Alternative 1 Active – Active	Alternative 2 Active – Hot Standby	Alternative 3 Active – Warm Standby	Alternative 4 Active – Cold Standby
Overall Score	241	281	294	263
Ranking	4	2	1	3
Screen	Pass	Pass	Pass	FAIL
SUMMARY	Overbuilds for State requirements. State applications not built for active-active and business operations don't require it.	Meet's recovery time objectives for State's most critical applications. Highest cost. State should use Hot and Warm standby on an application by application basis.	Meets recovery time objectives for State's important applications. Lower cost than Hot Standby. State should use Hot and Warm standby on an application by application basis.	Does not meet State's minimum requirements for availability and disaster recovery.

To understand the detailed analysis, see appendix materials at the end of this report

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Key questions to be answered by the Data Center Future State Vision

A new ~10,000 sq. foot, Tier 3 data center is required to meet the State's capacity and availability requirements. The DR facility needs to be at least a Tier 2 facility with at least 60% of the capacity of the primary centers. The Satellite centers will be small server rooms equipped with UPS and generator backup.

A. What types of data centers does the State require?

B. How many data centers does the State require?

C. **How large and robust does each data center need to be?**

D. Where should the data centers be located?

E. How should the data centers be sourced (build, leased retrofitted, rented or cloud)?

F. What core services should the new data center provide?

G. How much will the future state vision cost?

H. When can the new data centers be operational?

Rationale

Size

- Gartner's capacity model which is based in inputs from the recent Benchmarking exercise as well as specific inputs from many key departments indicates the following requirements for the Primary Core data center
  - Minimum 10,000 square foot computer room
  - 1.5-2.0 megawatt power capacity
  - ~50,000 square foot building on a 4.3 acre site
- The Disaster Recovery center will require 60-80% of the capacity of the Primary Core data center.
- Satellite centers will be <500 sq ft. with a ~150kw initial power capacity.

Robustness

- The Primary Core data center must be built to a Tier 3 standard for the following reasons
  - 7x24x365 operations are required
  - Scheduled outages for power and equipment maintenance are not acceptable
  - Tolerance for extended facility downtimes cause by network, cooling or power equipment/path failures are not acceptable
- A lower Tier 2 standard for DR facilities is common and is considered acceptable
- A lower Tier 2 standard is also acceptable for the satellite data centers due to the lower impact of outages.

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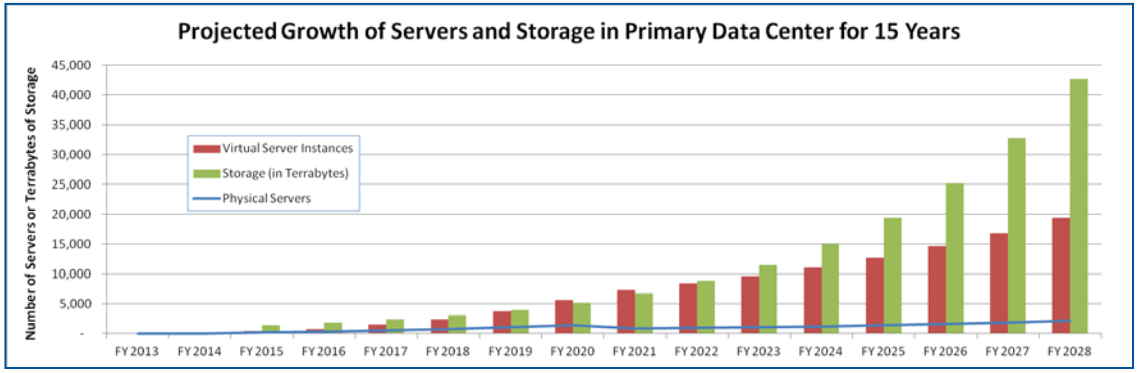
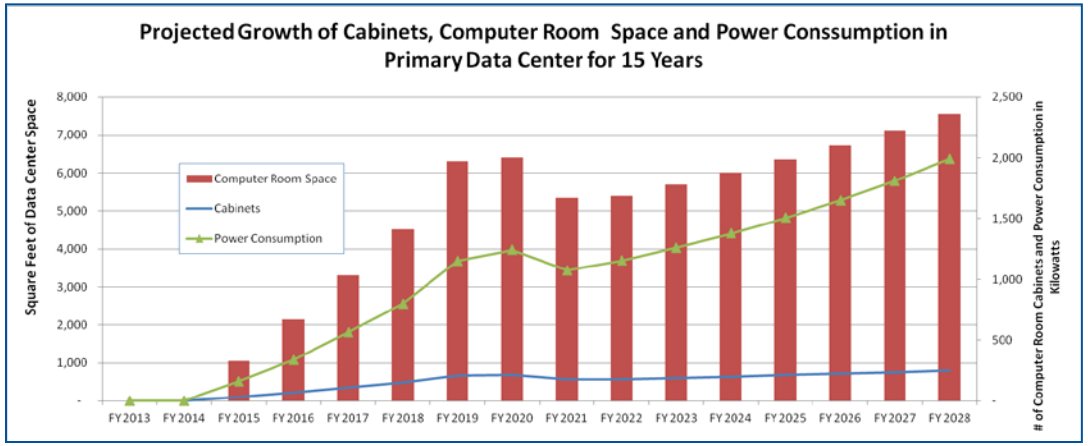
C. How large and robust does each data center need to be?

The 15 year capacity model projects the need for a minimum 10,000 square foot computer room with a power capacity of 1.5 to 2.0 megawatts.

- Key assumptions associated with the capacity model
  - Growth of server and storage based on historical patterns and transformation program projections
  - Majority of server and storage capacity delivered using efficient centrally managed, industrialized private cloud solution
  - Conversion to the above solution as part of the migration to the new data center
  - Collocated department servers and storage arrays declines from 40% during the transition period to 20-25% over the next 5-10 years
  - Data center construction takes 4+ years
  - Migration and consolidation occurs over a 5 year period
  - Equipment refreshed at least every 5 years to gain additional processing power and space/power consumption efficiency

Results from Gartner Capacity Model





To understand the model details , see appendix materials at the end of this report

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C. How large and robust does each data center need to be?

The Uptime Institute's "4 Tier" model is the industry standard for measuring data center robustness.

Tier Level	Typical Business Drivers and Characteristics	Effect on DC Design	Expected Downtime	Relative Cost
1	• Typically small businesses/organizations • Limited online presence • Low dependence on IT • Perceive downtime as a tolerable inconvenience	• Numerous single points of failure • No generator, UPS has 8-15 minutes of backup time • Extremely vulnerable to inclement weather conditions • Generally unable to sustain more than a 10 minute power outage	40+ hours per year	$1
2	• Some amount of online revenue generation or customer interaction • Small internal workforce dependent on IT and frequent outages not tolerable • Tolerance for scheduled downtime • On-line outages don't damage "brand"	• Some redundancy in power and cooling systems • Generator backup; Fire suppression system • Able to sustain 24 hour power outage • Minimal thought to site selection • Vapor barrier for humidity and air quality control • Formal data room separate from other areas	22 hours per year	$1.4
3	• Significant amount of online revenue generation or customer interaction. • Customers expect 7x24x365 presences • Large internal workforce highly dependent on IT: Outages have significant business impact • High cost of downtime • Outages damage "brand"	• Two utility paths (active and passive) • Redundant power and cooling systems • Redundant service providers • Able to sustain 72-96 hour power outage • Appropriate site; Purpose built facility • 7x24x365 Security and Operational Staffing • Fire suppression system; One-hour fire rating • Allows for concurrent maintenance	1.6 hours per year	$2.4
4	• Majority of revenue from online business • Downtime causes significant economic, or loss brand/market image damage • Significant customer or regulatory liability associated with down time	• Two independent utility paths • 2N power and cooling systems • Able to sustain indefinite power outage • Stringent site selection/facility design • Fire suppression system ; 2-4 hour fire rating • 7x24x365 Security and Operational Staffing	0.4 hours per year	$2.8

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C. How large and robust does each data center need to be?

The Uptime Institute's "4 Tier" model is the industry standard for measuring data center robustness.

Tier-1 – Basic Data Center

Tier-1 facilities have no redundant capacity components. This type of facility provides basic power and cooling with no excess capacity for backup or failover. There is no redundancy in the MEP distribution paths.

In a Tier-1 facility, unplanned outage or failure of a capacity component or distribution element will impact systems and customers. Maintenance needed for the MEP infrastructure to replace components or do utility work impacts the facility just as if there were an unplanned outage.

Tier-1 sites typically experience two separate 12-hour site-wide shutdowns per year for repair work. Additionally, Tier-1 sites typically experience 1.2 equipment or distribution component failures on average each year. This equates to 40 or more hours of downtime per year.

Tier-2 – Redundant Data Center

A Tier-2 data center has redundant capacity components, but only a single non-redundant distribution path serving the data processing equipment. The benefit of this level is that any redundant capacity component can be removed from service on a planned basis without causing the data processing to be shut down.

Tier-2 sites average one unplanned outage per year, and schedule three maintenance activities over a two-year period. The annual impact to operations is 22 hours of downtime per year, or 99.75% availability.

Tier-4 – Fault-Tolerant Data Center

Tier-4 sites have multiple, independent, and physically separate systems that each have redundant capacity components and multiple, independent, diverse and active distribution paths supporting all data processing. In a Tier-4 data center, any single failure of an MEP component or distribution path has no negative impact to the data processing systems.

Facility-related failures that impact the data processing equipment are statistically reduced to 0.8 hours per year at Tier-4 sites which yields 99.99% availability.

Tier-3 – Redundant Data Center with Concurrent Maintenance

A Tier-3 data center has redundant capacity components and multiple independent distribution paths serving the data processing footprint. There is sufficient MEP capacity to meet the needs of the data processing systems even when one of these redundant MEP components has been removed from the infrastructure. Tier-3 data center can support maintenance activities and some unplanned events without interruption to the computing systems.

Because of concurrent maintenance capability provided by Tier-3 facilities, no annual shutdowns for routine maintenance are required. Tier-3 data centers have unplanned events totaling only 1.6 hours per year. Tier-3 sites deliver 99.98% availability.

A Note About Tier Classifications

If any single system in a Tier-n data center does not meet the Tier-n requirements, then the facility, as a whole, is not Tier-n. With this in mind, fractional tier ratings such as 2+ or 3.5 have no meaning in a tiered classification context and should not exist.

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C. How large and robust does each data center need to be?

To meet the State's availability and recovery requirements, the new Primary Data Center should be built to a Tier 3. The DR data center should be at least a Tier 2, as should the Satellite data centers.

Summary of Alternatives Analysis – Data Center Tier

	Alternative 1 Tier 1	Alternative 2 Tier 2	Alternative 3 Tier 3	Alternative 4 Tier 4
Overall Score	233	279	314	276
Ranking	4	2	1	3
Screen	Fail	Pass	Pass	Pass
SUMMARY	Does not meet State's minimum requirements for availability and disaster recovery. Not a viable alternative.	22 hours of expected annual downtime does not meet availability needs for critical applications; not sufficient for State's primary data center. Could be sufficient for a secondary data center if the primary is Tier 3 or 4.	1.6 hours of expected annual downtime fully meets the State's availability needs for critical applications without overbuilding.	Provides the highest level of availability with .4 hours expected annual downtime. Highest cost and overbuilds for the State's requirements.

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Key questions to be answered by the Data Center Future State Vision

Locating the primary and secondary data centers on Oahu in geographically separated sites is optimal.

A. What types of data centers does the State require?

B. How many data centers does the State require?

C. How large and robust does each data center need to be?

D. **Where should the data centers be located?**

E. How should the data centers be sourced (build, leased retrofitted, rented or cloud)?

F. What core services should the new data center provide?

G. How much will the future state vision cost?

H. When can the new data centers be operational?

Alternatives Considered

1. Primary- Oahu, Secondary- Oahu
2. Primary- Oahu, Secondary- Neighbor Island
3. Primary- Oahu, Secondary- Mainland (co-lo or DR type outsourced service)
4. Primary- Mainland, Secondary- Mainland

Rationale

- Most of the State's IT system users are located on Oahu
- Oahu has the most resilient electrical transportation system. In addition, there is a robust federal presence (military/civilian)
- Locating one or more data centers on the mainland would introduce communications delays and could necessitate "outsourcing" significant numbers of Hawaii based jobs.
- It is possible that a disaster could halt communications to the mainland.
- Establishing the DR facility on a NI was considered but rejected because of concerns regarding the robustness of inter-island communication links during a disaster.
- Additionally, there are several existing Oahu facilities which could serve as a DR facility (UH, Kalanimoku, 2 Colo providers)

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D. Where should the data centers be located?

The State should location both Core data centers on Oahu, however they should be separated as much as possible to decrease the chances that a single disaster is likely to severely impact both Centers. As the inter-island network becomes more robust, the State may wish consider a DR site on Maui.

Summary of Alternatives Analysis – Core Data Center Location

	Alternative 1 Primary-Oahu Secondary-Oahu	Alternative 2 Primary-Oahu Secondary- Neighbor Island	Alternative 3 Primary-Oahu Secondary-Mainland	Alternative 4 Primary-Mainland Secondary-Mainland
Overall Score	326	273	113	83
Ranking	1	2	3	4
Screen	Pass	Pass	Pass	Pass
SUMMARY	Best positions State to successfully operate from secondary DC for extended period in case of disaster. Lowest power costs. Least connectivity risk.	Difficult for State IT staff to travel to/ operate secondary DC for extended period. Highest power costs. Interisland connectivity risk.	Requires outsourcing State DC which is not State strategy. Transpacific connectivity risk. Does not invest in Hawaii. May achieve timeframe for secondary DC only.	Requires outsourcing State DC which is not State strategy. Transpacific connectivity risk. Does not invest in Hawaii. Few/no timeframe benefits.

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Key questions to be answered by the Data Center Future State Vision

The State should build a new Primary Core Data Center and leverage the ICSD data center in the Kalanimoku building as the Disaster Recovery Center in the short run. Longer term, the State can evaluate other DR facility options.

A. What types of data centers does the State require?

B. How many data center does the State require?

C. How large and robust does each data center need to be?

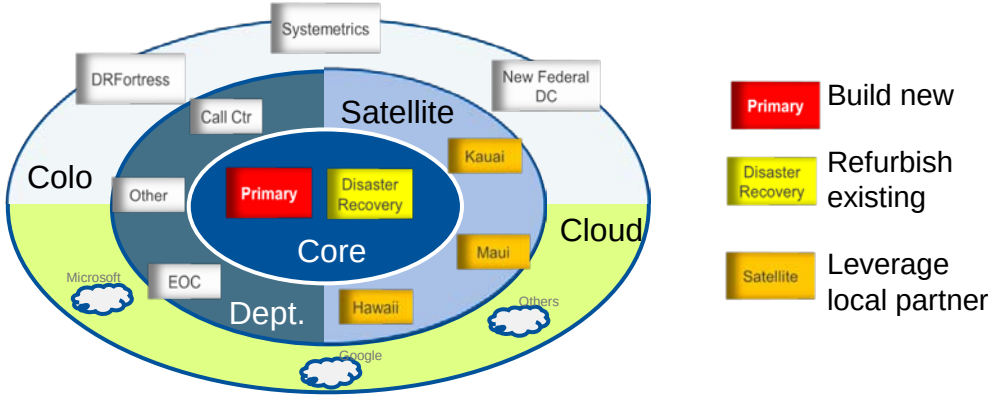
D. Where should the data centers be located?

E. **How should the data centers be sourced (build, leased retrofitted, rented or cloud)?**

F. What core services should the new data center provide?

G. How much will the future state vision cost?

H. When can the new data centers be operational?



Rationale

- Owning the data centers is the preferred option, however Co-location and Turnkey Data Center Leasing are also viable options.
- There are no existing State data centers which could be upgraded or otherwise leveraged as the State's Primary Core Data Center
- Therefore a new Primary Core Data Center must be built.
- There are several State data center facilities and a couple of collocation provider facilities which could server as the Secondary Core data center.
- Final analysis showed that the ICSD Kalanimoku data center with some refurbishing can serve the DR center role most cost effectively for at least the next 5 years

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E. How should the data centers be sourced?

Owning the data centers is the preferable option, however Co-location and Turnkey data center leasing are also viable options.

Summary of Alternatives Analysis – Own vs. Lease

	Alternative 1 Own Data Centers	Alternative 2 Use Co-location Facility	Alternative3 Turnkey Data Center Lease
Overall Score	317	228	241
Ranking	1	3	2
Screen	Pass	Pass	Pass
SUMMARY	Best long term benefits, lowest risk, lowest cost and leading practice. Does not make data center available by 2015.	Quickly available. Higher cost, higher risk due to lack of control over resources, lowest benefits.	Potential to make data center available by 2015 if vendor can complete process faster than State. Highest cost, cannot use Bond funds, vendor risk.

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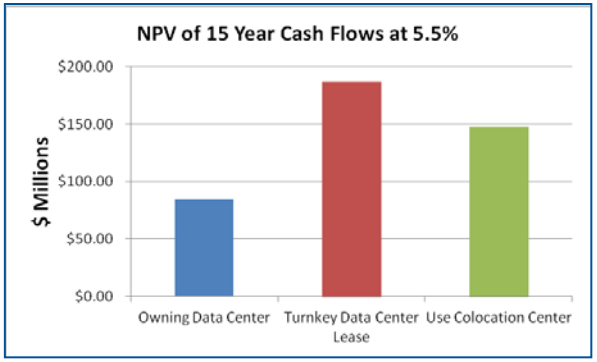
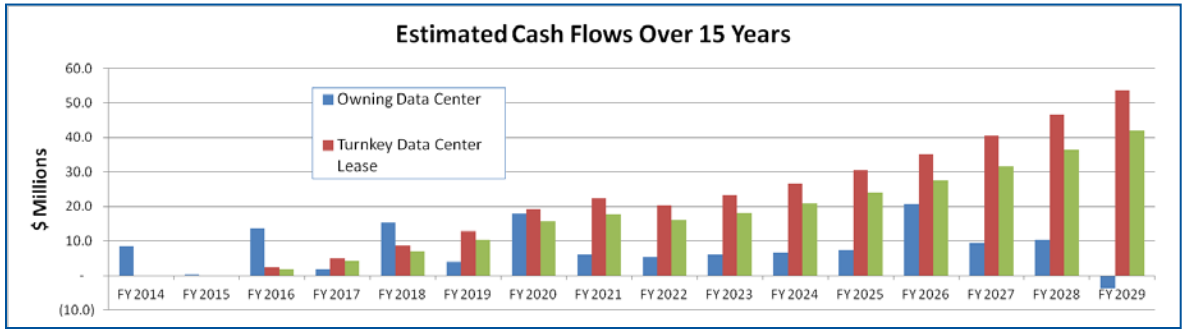
E. How should the data centers be sourced?

Financial analysis reveals that owning the data center is the most favorable option over the long term.

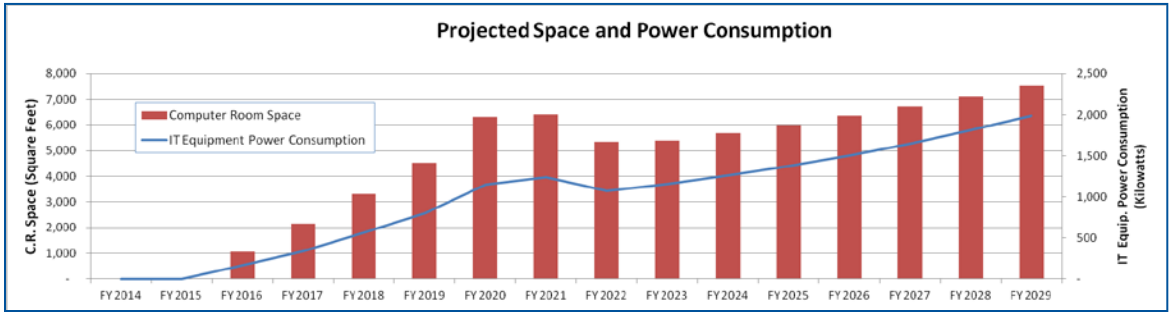
- Based on Gartner's cost model, owning data centers is the most favorable option as it has the lowest cash flow net present value of the estimated life of the data center
  - Note: The net present value (NPV) analysis for the Build option is net of the estimated residual value of the data center after 15 years.





Option	Cost Differential
Own Data Centers	$1.0
Use Co-Location Facility	$1.7
Turnkey Data Center Lease	$2.2

* Based on 15 Year cash flow NPV analysis net of estimated residual value



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E. How should the data centers be sourced?

A new data center should be constructed by the State on Oahu. It could be built on State Land or on Private Land acquired by the state. It should be built in the safest and most appropriate location.

Summary of Alternatives Analysis – Primary Data Center Sourcing

	Alternative 1 State Land – Renovate State Building	Alternative 2 State Land – New Building	Alternative 3 Buy Land – New Building	Alternative 4 Use DOE Data Center	Alternative 5 Use UH Data Center
Overall Score	261	307	284	0	0
Ranking	3	1	2	4	4
Screen	Pass	Pass	Pass	FAIL	FAIL
SUMMARY	Primary benefit is lower cost and some reduction in timeframe. May not meet the State's requirements as well as a new build due to constraints and build compromises.	Eliminates costs associated with buying land, and allows for a purpose-built data center structure which will best meet the State's requirements.	Gives the State the most flexibility in location and building to meet requirements, but is the highest cost alternative.	Does not meet the State's minimum requirements for long term capacity for a primary data center and is not a viable alternative.	Does not meet the State's minimum requirements for long term capacity for a primary data center and is not a viable alternative.

To understand the detailed analysis, see appendix materials at the end of this report

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E. How should the data centers be sourced?

While performing a site selection for the Primary Data center is outside the scope of this engagement, Gartner has identified criteria for selecting such a site and has identified a candidate location that meets most of them.

- While a formal site selection process was not conducted, Gartner did identify a potential candidate location that meets the proscribe criteria.
- The Mililani Technology Park is approximately 20 miles from Central Honolulu and has diverse power and telecommunication feeds available.
  - A number of commercial organizations have located sensitive operations in the this industrial park (telecom switching centers, data centers and call centers)
- The State also provided a partial inventory of State owned land to be considered. While no particular site stood out, further due diligence is warranted on both State land and other commercial sites.

Key Site Selection Criteria

- Sufficiently distant from secondary center to ensure that both centers are not impacted by the same disaster event.
- Outside of fire, flood, tsunami and earthquake risk zones
- Served by multiple power grids or substations with load switching capability
  - Sufficient power capacity available (at least 3 megawatts)
- Ability to have dual fiber optic entrances/paths to provide telecommunications redundancy
- Away from sources of vibration and high-risk sources, such as airports, rail lines
- Local authorities amenable to use of land for a data center facility (appropriate zoning, no adverse impacts on local traffic patterns). Light industrial is ideal.
- Away from residential or other sound-sensitive uses
- Within one hour commute from major population centers
- Sufficient land to allow for surface parking and for a sufficient set back from property lines to allow for the establishment of a secure perimeter.
  - Away from neighboring structures (if possible fenced off)
- Good transportation access
  - Major highways with multiple routes in an out of the areas
  - Within 1 hour commute from major population centers, airports & ports
- Single story, standalone building with limited fenestration.
  - Level roof without skylights
  - Single point of entry for people
  - Dedicated loading docks for equipment delivery access
  - Large floor plates; large column bays (30’x50’ is ideal)
  - Minimum 13'-6" clear from structural slab to lowest structural member

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E. How should the data centers be sourced?

The existing ICSD data center in the Kalanimoku Building should be leveraged as the State's DR facility for the next 5-7 years. This will save the State the expense of building a DR center. This recommendation may also influence the site selection process for the primary data center.

Summary of Alternatives Analysis – Secondary Data Center Sourcing

	Alternative 1 Use ICSD Data Center	Alternative 2 Use DOE Data Center	Alternative 3 Use UH Data Center	Alternative 4 Use Commercial Co-Location Facility	Alternative 5 Build New in Existing State Office Space
Overall Score	322	0	0	250	268
Ranking	1	4	4	3	2
Screen	Pass	FAIL	FAIL	Pass	Pass
SUMMARY	Immediately available, leverages existing resources, lowest cost alternative, no vendor risk, State control over resources. Some issues with location cannot be resolved.	Does not meet State's minimum requirements for long term capacity for a secondary data center. Not a viable alternative.	Does not meet State's minimum requirements for long term capacity for a secondary data center. Not a viable alternative.	Short time to implement and meets availability and DR needs. Cannot be funded using bonds and reduces State control over resources.	Eliminates vendor risks associated with co-location and gives State control over resources/services. Longest time to implement and more costs and risks than improving/using ICSD.

To understand the detailed analysis, see appendix materials at the end of this report

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E. How should the data centers be sourced?

The State should partner with Counties to create a secure, State-controlled environment in modern County-owned Data Center Facilities. This option is appropriate for Hawaii and possibly for Maui. If adequate facilities do not exist on Kauai, the State should examine the use of the State Office Building.

Summary of Alternatives Analysis – Neighbor Island Participation

	Alternative 1 Improve/Expand Existing State Dept Server Closets on Neighbor Islands	Alternative 2 Build State Controlled Caged Environments in Existing/Planned County Data Centers	Alternative 3 Build State Data Centers on Neighbor Islands
Overall Score	316	316	256
Ranking	1	1	3
Screen	Pass	Pass	Pass
SUMMARY	Leverages existing State investments, could reduce timeframe, State maintains control over technology resources. More expensive than using County space. Potentially feasible on Maui and Kauai. Additional review required.	Leverages modern County facilities. Best option for Hawaii Island. Reduces State control over resources, may have increased timeframe as new Maui facility is in early planning stages.	Gives the State the most control over resources. Highest cost and will take the longest to achieve.

To understand the detailed analysis, see appendix materials at the end of this report

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Key questions to be answered by the Data Center Future State Vision

To be successful, the State will have to fundamentally transform the way data center services are delivered. A set of flexible, industrialized services that can be tailored to different requirements is needed.

A. What types of data centers does the State require?

B. How many data center does the State require?

C. How large and robust does each data center need to be?

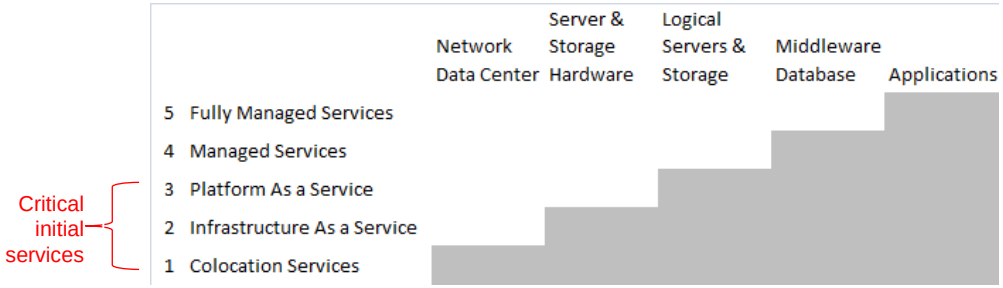
D. Where should the data centers be located?

E. How should the data centers be sourced (build, leased retrofitted, rented or cloud)?

F. **What core services should the new data center provide?**

G. How much will the future state vision cost?

H. When can the new data centers be operational?



Rationale

- To be successful, Hawaii needs to do more than just consolidate its IT world loads into a new facility.
- The vast majority of server and storage services need to be moved from a “physical server per application” model to an industrial scale, fully virtualized private could service.
- To do this, the State will need to master the new virtualization and private cloud technologies and redesign operational and financial (chargeback) processes around these new capabilities.

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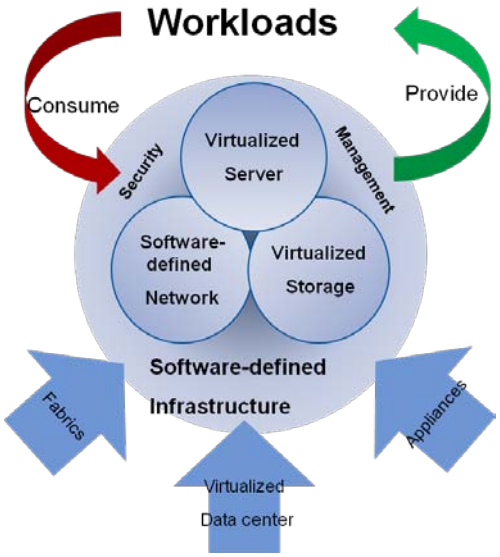
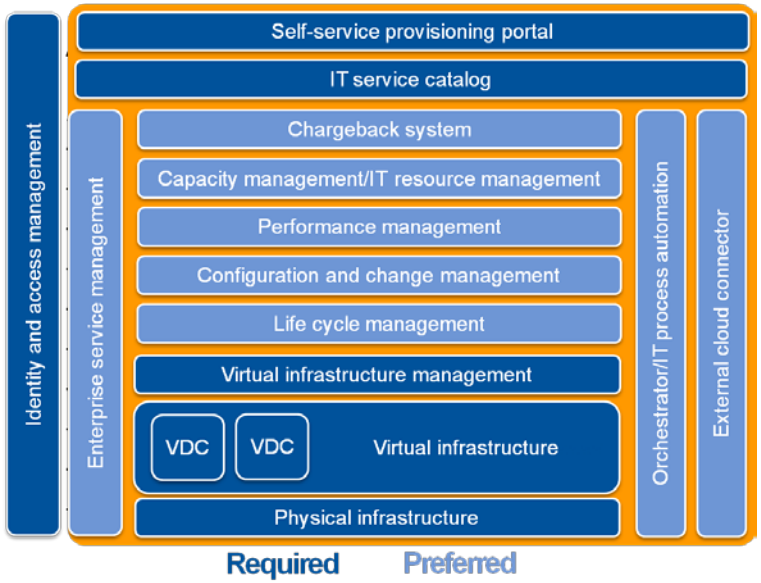
F. What core services should the new data center provide?

The most critical services offered by the new data center (IaaS and PaaS) will require the State to build and operate an advanced, industrial scale private cloud infrastructure.

- The State will build a converged and virtualized network, storage and server infrastructure within the new data center.
- Most server and storage workloads will be migrated from department servers to the converged infrastructure as part of the migration process



Key Components of Private Cloud Infrastructure



- The State may need to engage external resources or organizations to build and operate the private cloud infrastructure, while at the same time affecting knowledge transfer to the State's data center staff.

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Key questions to be answered by the Data Center Future State Vision

A substantial investment will be required over the next four years to fund the data center program

A. What types of data centers does the State require?

B. How many data centers does the State require?

C. How large and robust does each data center need to be?

D. Where should the data centers be located?

E. How should the data centers be sourced (build, leased retrofitted, rented or cloud)?

F. What core services should the new data center provide?

G. **How much will the future state vision cost?**

H. When can the new data centers be operational?

Data Center Program Budget Requests

FY 2013-14: $TBD
FY 2014-15: $TBD
FY 2015-16: $TBD
FY 2016-17: $TBD

Rationale

- FY 14 spending request will primarily fund land acquisition
- FY 15 spending request will fund design of the new data center
- FY 16 spending request will fund construction of the data center building, NOC facility and space for 75 data center staff. It will also fund the first build out
- FY 17 spending request will fund seed IT infrastructure to facilitate the migration of initial departmental data centers.
- All requests include funding for the Data Center Program Office and for Data Center Migration Planning

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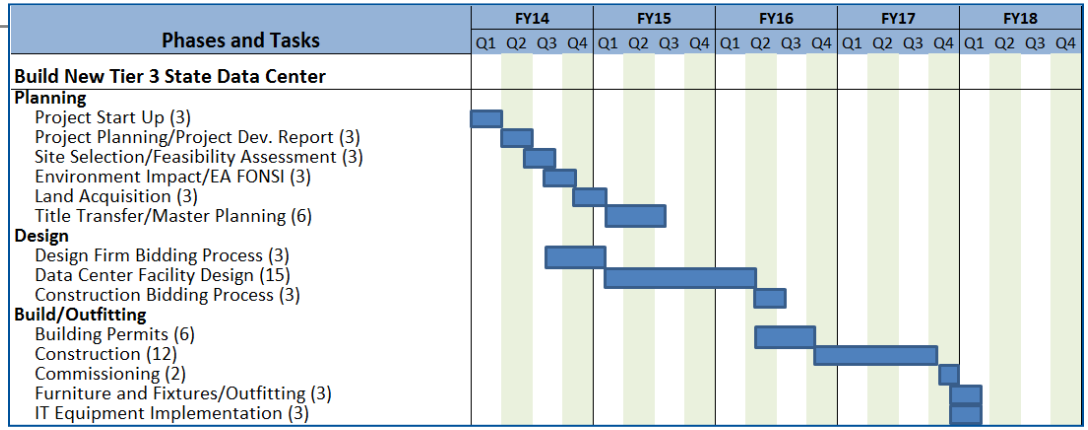
Key questions to be answered by the Data Center Future State Vision

Based on typical construction timelines provided by DAGS, it appears that constructing the new data will require approximately 4 years (50 months) from the start of the planning process until readiness for the installation of the first system.

- A. What types of data centers does the state require?
- B. How many data center does the state require?
- C. How large and robust does each data center need to be?
- D. Where should the data centers be located?
- E. How should the data centers be sourced (build, leased retrofitted, rented or cloud)?
- F. What core services should the new data center provide?
- G. How much will the future state vision cost?
- H. **When can the new data centers be operational?**



Rationale

- Based on construction guidelines provided by DAGS it will take at least 4 years to construct the State's new Tier 3 Data Center
- Time line is based on the following key assumptions
  - The approval process by the Legislature and Control agencies occurs quickly
  - The selected location is available for purchase, is appropriately zones, poses not environmental challenges and has ready access to the require utility and telecommunications feeds.

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Part 3: Migration Plan

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High Level Migration Time Line

- **Building a Tier 3 data center will take approximately 4 years (50 months) based on timing parameters provided by DAGS.**
- The State should establish a Project Management Office (PMO) to oversee the Data Center Program.
  - Critical meetings should be held to ensure the required alignment between the Data Center program and the ERP program, Tax System program, and other new system implementation projects as they emerge.
- It appears, based on preliminary deployment dates provided by the ERP and Tax System teams, than an interim solution for hosting those systems may be needed. Interim solutions include:
  - Have the system vendor host the solution until the new data center is operational
  - Use an on-island collocation vendor.
- Kalanimoku should be renovated as a secondary data center once the State has moved into the new primary facility.
- Detailed migration timeframes should be developed once the migration planning has been completed.

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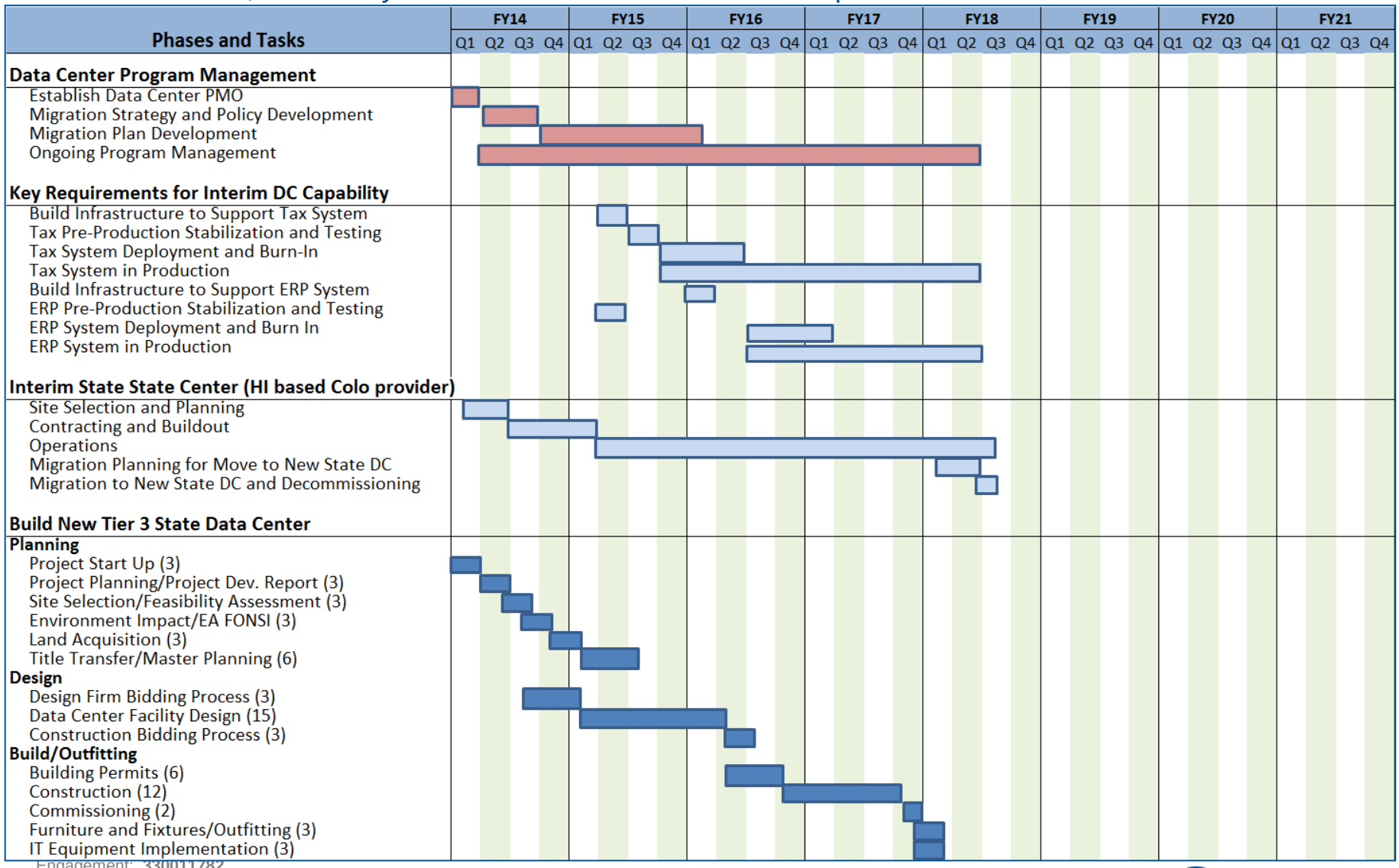
Mid-Level Migration Timeline

Unfortunately, it appears that the new State data center cannot be completed in time to support the new Tax and ERP systems. Either these will need to be hosted by the implementation vendors or located in interim State DC, most likely at one of the on-island collocation providers.



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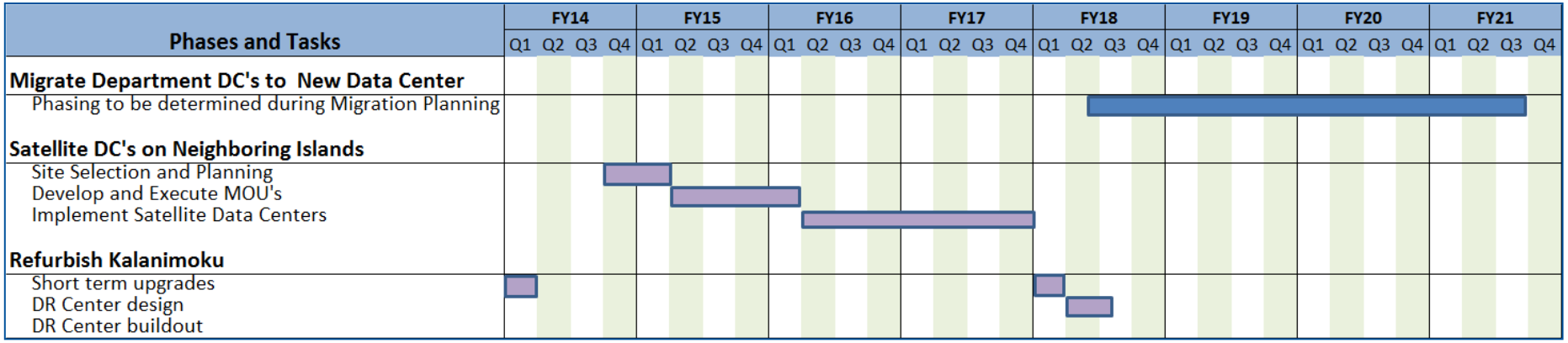
Mid-Level Migration Timeline (continued)



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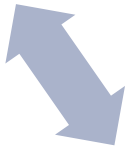
Key Elements of the State's Data Center Project – Scope, Budget and Schedule

Scope

Construct a modern Tier 3 primary data center at an interior location on Oahu to ultimately house all of the State's primary IT assets.

Refurbish the ICSD data center in the Kalanimoku Building and repurpose it as the State's interim Disaster Recovery center.

Create a State data center presence on Hawaii, Maui and Kauai through partnerships with the Counties and establishment of secure State-controlled environments within modern County-owned data center facilities. Provide Counties with space in the new State data center for off-island disaster recovery.



Budget

Substantial investment is required

Schedule

~ 4 years (50 months) to complete construction of new primary data center

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Key Migration Risks

As part of the Strategic Analysis, a number of key migration risks were identified along with potential mitigation activities

Risks	Potential Mitigations
The ERP and Tax systems require data center capability by end of 2015, which is 2 years earlier than the new DC will ready	• Plan for the production ERP systems to be hosted at an on-island collocation provider while the new DC is being constructed, then migrate the systems to the new DC • Reevaluate this strategy as the completion dates of the ERP and DC projects are finalized
State land acquisition, planning and impact processes may take significantly more time than the plan assumes	• Establish strong sponsorship by the Governor and key legislative leaders to ensure that planning and approval activities are closely managed and expedited • Strongly prefer a site located in a pre-zoned light industrial area where potential impacts have already been vetted
The State may overbuild data center capability or capacity that is not used immediately	• Adhere to the modular build out schedule described in the strategy • Enact legislation or an executive order requiring Departments, absent a formal waiver, to locate servers, storage and related IT assets in a State data center • In parallel with building the new data center, work with the individual Departments to develop migration plans for their existing and planned assets
The primary data center build will take ~4 years, during which, the State will be exposed to the risks outlined in this report and several others	• Perform a study to identify and register the most critical IT systems • Develop a short term plan for recovering these systems quickly (e.g. ensure that the data is replicated to a secure location)
Building a new data center and migrating thousands of assets from dozens of different organizations is a complex undertaking with many dependencies which must be actively managed	• Establish and fund a data center build and migration Program Management Office within OIMT, reporting to a senior, empowered executive. • Charter the DC PMO to manage the data center build, create the policy framework required to compel usage of the new DC's and work collaboratively with the Departments to plan the migration of their assets to the new data centers.

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Appendices

Appendix A: Summary of Current Environment
Appendix B: Analysis of Strategic Alternatives
Appendix C: Acronyms and Glossary

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Appendix A: Summary of Current Environment

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Current State Applications

- According to the State's Business and IT /IRM Transformation Strategic Plan, the Executive branch of Government of the State of Hawaii is a large $ 11 Billion Business enterprise with 18 departments, and 41,000 employees serving 1.4 M residents/citizens with 204 services across 34 LOB's. The concomitant IT organization is a $ 157 Million (1.5%) enterprise with no central Department of IT, 746 IT staff fragmented across 18 organizations, supporting over 700 legacy systems and applications and one LOB (6 functions).
- Of the State's 744 applications, at least 155 (or ~20%) are hosted at the ICSD Data Center in the Kalanimoku Building. These include critical applications such as:
  - Finance, Statewide Payroll, Employee Retirement
  - Welfare, Food Stamps, Foster Care, Child Protection, Disability Insurance, Unemployment Insurance
- The remaining applications are housed in server rooms or server closets, many lacking basic features such as adequate security, cooling, generators and protection from flooding.

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Current State of Hawaii Data Centers

- The State has 26 locations where servers are housed. Most are Server Rooms of less than 500 square feet.
- Approximately 589 applications (80% of the State's total) are housed outside of ICSD in server rooms or server closets, many lacking basic features such as adequate security, cooling, generators and protection from flooding.
- None of the currently existing locations fully meet the State's future requirements for a Tier 3 data center.

Department	Server Closet (<200 sq. ft.)	Server Room (<500 sq. ft.)	Data Center (>500 sq. ft.)
Legal (AG)		X	
CPJAD (AG)		X	
CSEA (AG)		X	
HCJDC (AG)		X	
B&F	X		
DAGS (non-ICSD)	X		
DBEDT	X		
DCCA		X	
DHHL		X	
DHRD		X	
DHS		X	
DLIR		X	
DLNR		X	
DOD		X	
DOE			X
DOH		X	
DOT		X	
DOTAX		X	
HDOA	X		
PSD		X	
UH			X
ICSD			X
GOV / LT. GOV	X		

Source: SAIC

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Critical Business Applications and RTOs

- According to a 2005 study of the State's Business Continuity and Disaster Recovery Strategies, the majority of the State's critical applications require Recovery Time Objectives (RTOs) ranging from zero to 24 hours.

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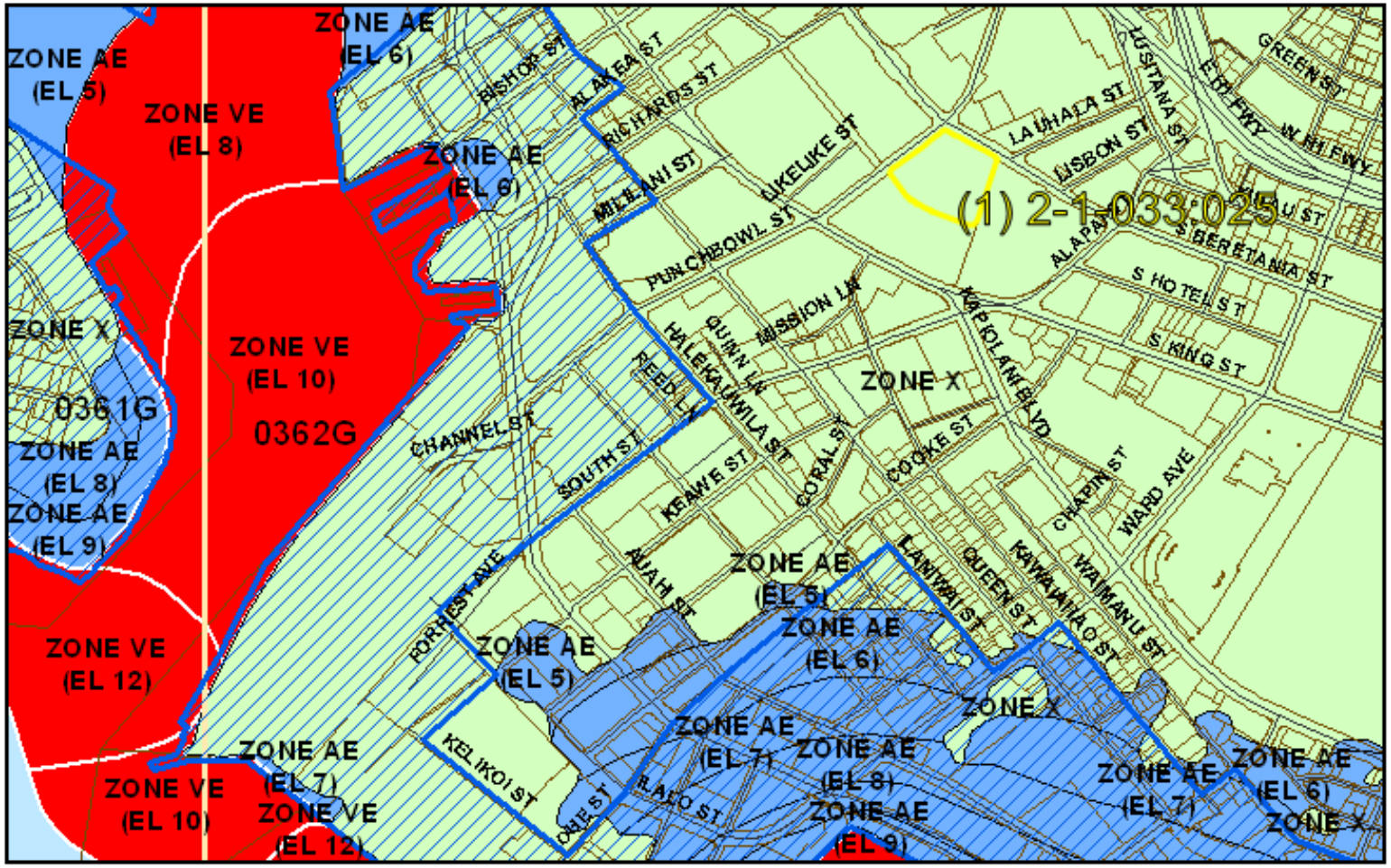
ISCD Data Center in the Kalanimoku Building is ~1700 feet from the Tsunami Evacuation Zone and within .5 miles of the storm surge/coastal floodplain. Other Departments, some with server rooms on the ground floor, are closer and at higher risk.



Tsunami Evacuation Zone

100-year Floodplain

100-year Floodplain with storm waves

– Generated using data from: NFIP Hawaii - National Flood Insurance Program Flood Hazard Assessment Tool

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Current State of Hawaii Servers and Storage

Current Environment*	Executive Branch	Legislative Branch	Judicial Branch	State Records and Archives	TOTAL
Total Physical Servers	1,665	12	87	2	**1,756**
Total OS Instances	2,202	15	87	20	**2,324**
Total Raw Configured Storage (TBs)	580	30	31	75	**716**

Note: Expected future capacity requirements, discussed elsewhere in this report, are based on these numbers, plus anticipated growth, plus capacity required for partner agencies such as the Counties.

*** Source:**

- Executive Branch: Gartner Benchmarking
- Legislative Branch: Branch provided
- Judicial Branch: Storage estimated based on average of Executive Branch Agencies; Branch provided OS instances.

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Planning Assumptions
Strategic Requirements

- To provide context and boundaries for this analysis, the State has identified the following strategic requirements:
  - **Hawaii First**
    - When expending funds, the State wants to invest those funds in Hawaii first, and other locations second. This will support the State's goal of economic growth and job creation.
  - **Shared Data Center to be available within 2 years (by end of 2014)**
    - This will provide a suitable home for the new ERP system (estimated Q4 2015), new Tax system (estimated Q2 2015), enterprise email and collaboration solutions, virtual desktop hosting and any other critical applications.
  - **Preference for Capital Expenditure (CapEx) vs. Operating Expenditure (OpEx)**
    - The State has a strong preference for using bond funds (also called Capital Improvement Project (CIP) Funds) for the implementation of the new shared data center solution.
  - **Consideration of stakeholder needs on neighbor islands**
    - The State would like a data center solution that involves stakeholders on neighbor islands and allows them to enjoy the benefits of the shared data center(s).

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Appendix B: Analysis of Strategic Alternatives

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Alternatives Analysis
Introduction (continued)

- A Red/Yellow/Green approach graphically depicts how well each alternative addresses the requirements/questions stated in the evaluation factors.

The alternative **fully achieves** the requirement described in the evaluation criterion.	
The alternative **partially achieves** the requirement described in the evaluation criterion, OR any **issues can be mitigated.**	
The alternative **does not achieve** the requirement described in the evaluation criterion.	

- In cases where an evaluation criterion does not apply to any alternative in the category, we have scored all alternatives in the category as green. This does not disadvantage any alternative and does not inadvertently indicate issues where there are none.

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Data Center Alternatives Summary

Category	Alternatives
1. Strategic Direction	• Own Data Centers • Use Co-location Facilities • Turnkey Data Center Lease
2. Number of Core Data Centers	• One Primary Data Center • Two Data Centers – Primary and Secondary • Multiple Core Data Centers
3. Role of Core Data Centers	• Active-Active • Active-Hot Standby • Active-Warm Standby • Active-Cold Standby
4. Location of Core Data Centers	• Primary- Oahu, Secondary- Oahu • Primary- Oahu, Secondary- Neighbor Island • Primary- Oahu, Secondary- Mainland (co-lo or DR type outsourced service) • Primary- Mainland, Secondary- Mainland

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Data Center Alternatives Summary (continued)

Category	Alternatives
5. Procurement – Primary Data Center	• Existing State land, renovate existing building • Existing State land, build new building • Buy land, build new building • Leverage planned Dept of Education DC facility (cafeteria and other related spaces) with appropriate capacity and redundancy upgrades as Primary • Leverage planned Univ of Hawaii DC with appropriate capacity and redundancy upgrades as Primary
6. Procurement – Secondary Data Center	• Leverage existing ICSD Data center with appropriate upgrades/changes • Leverage planned Dept of Education DC facility, if not used as primary • Leverage planned Univ of Hawaii DC facility, if not used as primary • Use Commercial Co-location Facility • Build new in existing available State office space
7. Data Center Facility Architecture	• Traditional • Modular • Container-Based
8. Neighbor Island Participation	• One or more Satellite Data Centers on Neighbor Islands • Other Approaches to Achieve Neighbor Islands Participation
9. Primary Data Center Tier	• Tier 1 • Tier 2 • Tier 3 • Tier 4

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1. Strategic Direction

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1. Strategic Direction
Summary of Analysis

Category	Alternatives
1. Strategic Direction	• Own Data Centers • Use Co-location Facilities • Turnkey Data Center Lease

	Alternative 1 Own Data Centers	Alternative 2 Use Co-location Facility	Alternative3 Turnkey Data Center Lease
Overall Score	317	232	274
Ranking	1	3	2
Screen	Pass	Pass	Pass
SUMMARY	Best long term benefits, lowest risk, lowest cost and leading practice. Does not make data center available by 2015.	Quickly available. Higher cost, higher risk due to lack of control over resources, lowest benefits.	Potential to make data center available by 2015 if vendor can complete process faster than State. Higher cost than State build, cannot use Bond funds, vendor risk.

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1. Strategic Direction – Summary of Analysis

1. Strategic Direction		Alternatives		
Section	Evaluation Criteria	Alt 1 Own Data Centers	Alt 2 Use Co-Lo Facility	Alt 3 Turnkey Data Center Lease
Cost	Ongoing Total Cost of Ownership			
	Ability to use bonds to fund implementation			
Requirements	Meet disaster recovery requirements & mitigate existing risks			
	Reduce environmental footprint			
	Improve facility availability and reliability			
	Meet data security and protection requirements			
	Meet required application service levels			
	Maximize economic benefit to the State of Hawaii			
	Improve the skills of the State IT workforce			
	Meet the State's long term anticipated capacity needs			
	Ability to adjust capacity to meet changing demand			
	Position the State to leverage new technologies			
	Maximize State control over technology assets			
	Maximize State Department control over services			
	Ability to Support Neighbor Island needs or achieve benefits			
Time	Time to implement new data center			
Risk	Ability to implement new data center(s) on-time/budget			
	Minimize project cost estimate variability			
	Ability of the State to successfully operate/maintain data center			
	Minimize operational disruption (due to migration or failures)			
	Minimize potential for vendor/market disruption			
	Allow predictability and control over long term costs			
	Aligned with best practices or technology trends			
	Minimize potential for one disaster to impact all data centers			
Screening	Meets State's minimum long term anticipated capacity needs	Pass	Pass	Pass
	Meets State's minimum requirements for availability/disaster recovery	Pass	Pass	Pass
Overall Score		317	232	274
Ranking		1	3	2
Screen		Pass	Pass	Pass

Engagement: **330011782**

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1. Strategic Direction
Qualitative Analysis

Alternative	Rank	Analysis
Own Data Centers	1	▪ The State gains **maximum benefits long term by owning its own data centers.** Key benefits are: • Significantly lower cost as compared to using co-location long term. See following pages for summary of the cost comparison. • Better control over technology assets and services • The ability to use bond funds to finance data center implementation • Owning data centers in the long term is leading practice for States, as co-location facilities are often high cost longer term. ▪ The **primary issue with owning is the time required to build a new State data center.** The State will need to host the new Tax system by mid-2015 and the new ERP system by the end of 2015. A newly constructed State data center will not meet this time requirement.
Use Co-location Facilities	3	▪ Using a co-location facility for the long term **has higher costs and risks** associated with it when compared to owning: • Higher costs than owning. Costs for co-location in the first 5 years are less than owning. Costs at 10 years are equal to owning. At 15 years, costs are significantly higher than owning. • Risk of the vendor raising prices in the future, going out of business, or otherwise disrupting service. • The State cannot use bond funds to finance the use of a co-location facility. To ensure ongoing operation of a co-located data center, operating budget must be secured in the long term. Long term operating funds are not guaranteed in the State of Hawaii as needs/ priorities change. ▪ The primary benefit is that a **co-location facility would meet the State's timeframe** for hosting new systems. The State could achieve this benefit by using a co-location facility temporarily as part of its migration strategy, while building a data center for the long term.

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1. Strategic Direction
Qualitative Analysis

Alternative	Rank	Analysis
Turnkey Data Center Lease	2	▪ This alternative entails having a private company build the data center and then lease it to the State. ▪ This alternative is **more expensive than owning and does not allow the State to use bond funds.** • This alternative reduces initial capital investment , but it does not allow the State to use bond funds and requires operating budget. To ensure ongoing operation of a leased data center, operating budget must be secured in the long term. Long term operating funds are not guaranteed in the State of Hawaii as needs/ priorities change. • Risk of the vendor changing terms, going out of business, or otherwise disrupting service. ▪ When compared to co-location, this alternative provides greater State control over the facility and resources since the facility will be built for and leased only to the State. However, the State is still exposed to some vendor-related risk. ▪ The primary benefit of this approach is that it **may better meet the State's timeframe**. This is based on the assumption that a commercial vendor can acquire/use existing vendor-owned land, design, construct and commission a data center faster than the State can do this using its required process.

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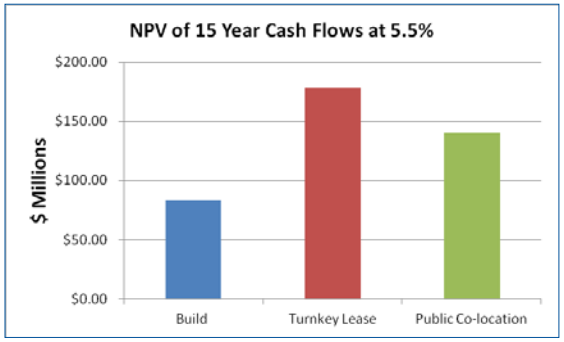
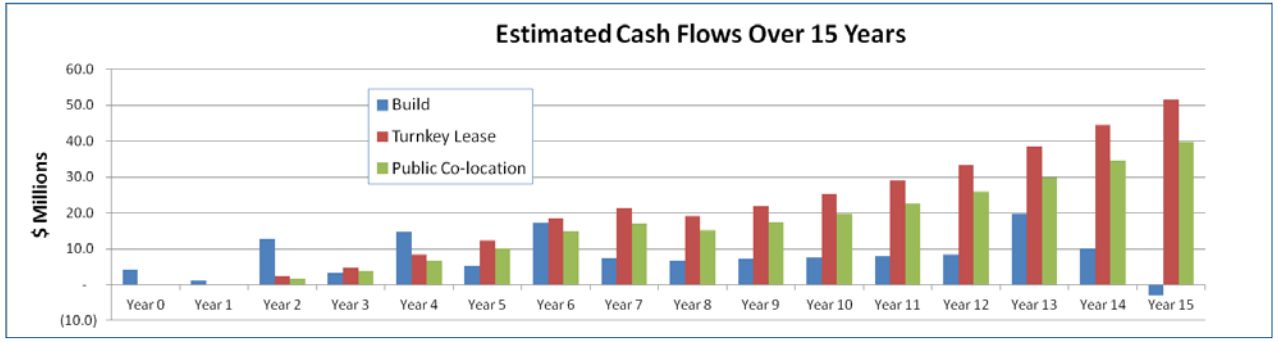
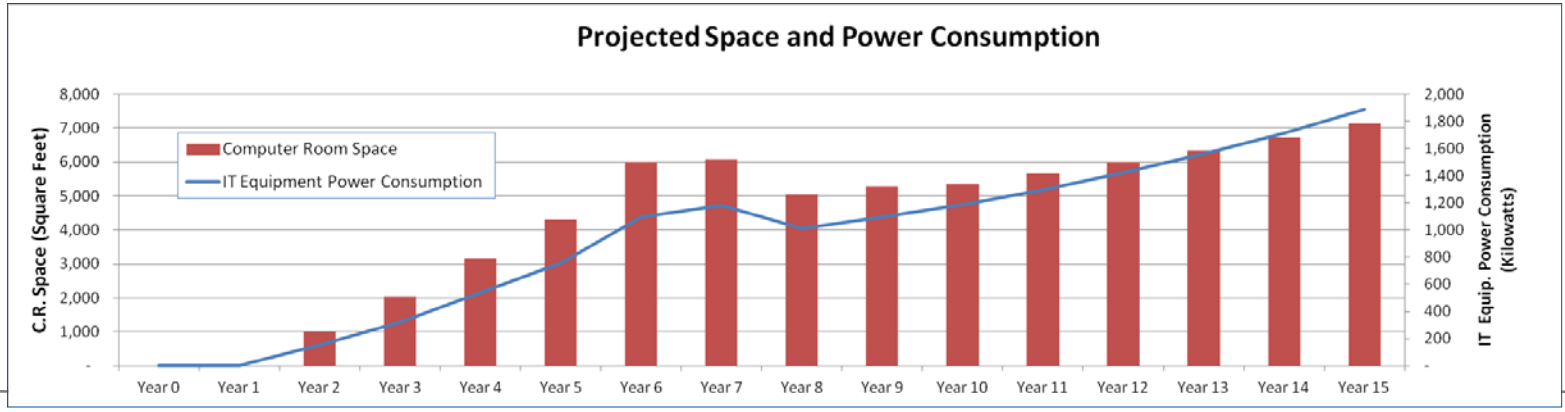
1. Strategic Direction
Cost Comparison Summary: Owning Data Center vs. Using Co-location Facilities

- Based on Gartner cost model, Building is the most favorable option as it has the lowest cash flow net present value of the estimated life of the data center
  - Note: The net present value (NPV) analysis for the Build option is net of the estimated residual value of the data center after 15 years.







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1. Strategic Direction
Possible Partnership Opportunities

- **Federal Government Renewable Energy Data Center**
  - The Federal Government is undertaking a feasibility study to determine the commercial viability of building a new data center facility in the State that is powered by renewable energy. The goal of this facility is to improve information security through energy security.
  - The hypothesis being tested is for a large data center complex, up to 20MW, to be built with private funding, leased to Federal Government agencies and other agencies under long-term lease agreements, including the State and commercial entities. The data center complex would be powered using a renewable energy plant to be constructed adjacent to the complex.
  - A long term lease arrangement would require that the State use operating funds. There may be other ways to participate that would allow the State to use bond funds. Those possibilities should be more fully explored as the Federal project progresses.
  - The Federal Government would like to achieve some "early wins" in the 2015/2016 timeframe. As the study is only in the feasibility stage, early wins have yet to be defined but could take different forms. An early win could be just identifying the site for the new data center, or it could be breaking ground, or having something operational.
  - **The State should continue to communicate with the Federal Project Team to explore opportunities to partner as the project continues through the planning stages.**

- **Department of Defense Emergency Operations Center**
  - The Department of Defense (DOD) is in the early planning stages of a new Emergency Operations Center. This would be used by State Civil Defense and potentially other agencies.
  - **The State should continue to communicate with the DOD Project Team to explore opportunities to partner as the project continues through the planning stages.**

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Future State Vision: Other Sourcing Options

A The data center strategic analysis considered two alternative methods of sourcing the primary data center which have the potential to deliver required data center capabilities up to 2 years earlier than the recommended solution.

- **Public Private Partnership – Turnkey Data Center Lease**
  - The data center strategic analysis considered an approach in which the State would contract with a Turnkey Data Center Provider to build a data center for exclusive use of the State. In this scenario, the State would enter into a 7-15 year lease of the data center facility and thereby avoid the upfront capital expenditures as well as the complexity of acquiring land, permits, approvals and managing a construction project.
  - Examples of potential public private partnership partners include: Commercial data center developers/REITs, critical facility construction firms, data center service providers, colocation providers, and cloud service providers.
  - This approach was rejected largely because of the State's desire to fund as much of the new data center construction through capital (e.g., bond) funding. The data center strategic analysis clearly showed that this approach could be implemented 1-3 years faster than the recommended State-managed build process.
  - **If the State's strong preference for bond funding changes, then the Public Private Partnership – Turnkey Data Center Lease becomes a viable option.**
- **Public Private Partnership – Turnkey Data Center Build**
  - Another option for acquiring a data center would be to contract with a third party data center construction firm or turnkey data center leasing firm to acquire land, build a turnkey data center on that land and then sell the completed asset to the State. While this is not a common practice, inquiries with key Data Center Turnkey Lease providers indicate that this is a service that is provided.
  - While the data center strategic analysis did not consider this option in detail, it appears that this sourcing option could be implemented 1-3 years faster than the recommended State-managed build process.
  - **As the State decides on the process it wants to follow to build the new data center (typically: bid-design-bid-build or bid-design-build), it may wish to also consider a bid-turnkey-design-build option as well.**

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2. Number of Core Data Centers

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2. Number of Core Data Centers
Summary of Analysis

Category	Alternatives
2. Number of Core Data Centers	• One Primary Data Center • Two Data Centers – Primary and Secondary • Multiple Core Data Centers

	Alternative 1 One Primary Data Center	Alternative 2 Two Data Centers	Alternative 3 Multiple Core Data Centers
Overall Score	183	308	232
Ranking	3	1	2
Screen	FAIL	Pass	Pass
SUMMARY	Unacceptable level of risk for long term disruption of service if the single primary data center is incapacitated.	Meets availability, reliability and disaster recovery needs at lower cost, complexity and risk than multiple core DCs. Leading practice.	Overbuilds for State requirements, adding complexity, risk and significant cost.

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2. Number of Core Data Centers – Summary of Analysis

2. Number of Core Data Centers		Alternatives		
Section	Evaluation Criteria	Alt 1 One Primary	Alt 2 Two Core DCs	Alt 3 Multiple Core DCs
Cost	Ongoing Total Cost of Ownership			
	Ability to use bonds to fund implementation			
Requirements	Meet disaster recovery requirements & mitigate existing risks			
	Reduce environmental footprint			
	Improve facility availability and reliability			
	Meet data security and protection requirements			
	Meet required application service levels			
	Maximize economic benefit to the State of Hawaii			
	Improve the skills of the State IT workforce			
	Meet the State's long term anticipated capacity needs			
	Ability to adjust capacity to meet changing demand			
	Position the State to leverage new technologies			
	Maximize State control over technology assets			
	Maximize State Department control over services			
	Ability to Support Neighbor Island needs or achieve benefits			
Time	Time to implement new data center			
Risk	Ability to implement new data center(s) on-time/budget			
	Minimize project cost estimate variability			
	Ability of the State to successfully operate/maintain data center			
	Minimize operational disruption (due to migration or failures)			
	Minimize potential for vendor/market disruption			
	Allow predictability and control over long term costs			
	Aligned with best practices or technology trends			
	Minimize potential for one disaster to impact all data centers			
Screening	Meets State's minimum long term anticipated capacity needs	Pass	Pass	Pass
	Meets State's minimum requirements for availability/disaster recovery	Fail	Pass	Pass
	Overall Score	201	317	271
	Ranking	3	1	2
	Screen	FAIL	Pass	Pass

Engagement: **330011782**

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2. Number of Core Data Centers
Qualitative Analysis

Alternative	Rank	Analysis
One Primary Data Center	3 **FAIL**	▪ A single primary data center does meet the State's minimum requirements for availability and disaster recovery. **This approach exposes the State to an unacceptable level of risk for long term disruption of service if the single primary data center is incapacitated.** This is a Pass/Fail screening criterion and this alternative has failed on this criterion.
Two Data Centers – Primary and Secondary	1	▪ Two primary data centers, a primary and secondary, provides the State with the **greatest benefits and least risk**: • Meets the State's requirements for disaster recovery and availability assuming that the two data centers are geographically separated in order to prevent a single disaster from incapacitating both data centers • Lower cost and lower operational risk when compared to building and operating multiple core data centers. ▪ This alternative is consistent with leading practice, both among other states, and among commercial organizations with availability and disaster recovery needs similar to the State of Hawaii.
Multiple Core Data Centers	2	▪ Multiple core data centers is typically required only for organizations with extremely high availability requirements. **This level of availability is not a requirement of the State**. ▪ Building and operating multiple core data centers significantly more costly than owning/operating a primary and secondary data center. ▪ This alternative exposes the State to operational risk as it is more complex and challenging to operate multiple core data centers than focusing efforts on operating a primary data center, as the State traditionally has done, and ensuring adequate disaster recovery capability in a secondary data center.

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3. Role of Core Data Centers

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3. Role of Core Data Centers

Category	Alternatives
3. Role of Core Data Centers	• Active-Active • Active-Hot Standby • Active-Warm Standby • Active-Cold Standby

	Alternative 1 Active – Active	Alternative 2 Active – Hot Standby	Alternative 3 Active – Warm Standby	Alternative 4 Active – Cold Standby
Overall Score	241	281	294	263
Ranking	4	2	1	3
Screen	Pass	Pass	Pass	FAIL
SUMMARY	Overbuilds for State requirements. State applications not built for active-active and business operations don't require it.	Meet's recovery time objectives for State's most critical applications. Highest cost. State should use Hot and Warm standby on an application by application basis.	Meets recovery time objectives for State's important applications. Lower cost than Hot Standby. State should use Hot and Warm standby on an application by application basis.	Does not meet State's minimum requirements for availability and disaster recovery.

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3. Role of Core Data Centers
Alternative Definitions

Alternative	Definitions
Active-Active	– Data replicated simultaneously, no loss of data, RPO=0 – RTO = seconds to minutes
Active-Hot Standby	– Data replicated with compute hardware – RTO = minutes to hours
Active-Warm Standby	– Data replicated with some limited pre-built compute infrastructure – RTO = days
Active-Cold Standby	– Backup to tape, recovery center/process – RTO = weeks

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3. Role of Core Data Centers – Summary of Analysis

3. Role of Core Data Centers		Alternatives			
		Alt 1 Active-Active	Alt 2 Active-Hot	Alt 3 Active-Warm	Alt 4 Active-Cold
Section	Evaluation Criteria				
Cost	Ongoing Total Cost of Ownership				
	Ability to use bonds to fund implementation				
Requirements	Meet disaster recovery requirements & mitigate existing risks				
	Reduce environmental footprint				
	Improve facility availability and reliability				
	Meet data security and protection requirements				
	Meet required application service levels				
	Maximize economic benefit to the State of Hawaii				
	Improve the skills of the State IT workforce				
	Meet the State's long term anticipated capacity needs				
	Ability to adjust capacity to meet changing demand				
	Position the State to leverage new technologies				
	Maximize State control over technology assets				
	Maximize State Department control over services				
	Ability to Support Neighbor Island needs or achieve benefits				
Time	Time to implement new data center				
Risk	Ability to implement new data center(s) on-time/budget				
	Minimize project cost estimate variability				
	Ability of the State to successfully operate/maintain data center				
	Minimize operational disruption (due to migration or failures)				
	Minimize potential for vendor/market disruption				
	Allow predictability and control over long term costs				
	Aligned with best practices or technology trends				
	Minimize potential for one disaster to impact all data centers				
Screening	Meets State's minimum long term anticipated capacity needs	Pass	Pass	Pass	Pass
	Meets State's minimum requirements for availability/disaster recovery	Pass	Pass	Pass	Fail
	Overall Score	241	281	294	263
	Ranking	4	2	1	3
	Screen	Pass	Pass	Pass	FAIL

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3. Role of Core Data Centers
Qualitative Analysis

Alternative	Rank	Analysis
Active-Active	4	▪ The **State has no applications that require, or are built for, active-active**. Current RTO for a sample of State Departments is shown below: • Civil Defense: Little/no downtime • Lands and Natural Resources: Little/no downtime • Human Services: Little/no downtime for HAWI and Child Protective Services • Transportation: 12 hours (Exception: Airports Accounts Receivable: 5 minutes) • Hawaiian Homelands: Little/no downtime during business hours; up to 12 hours outside business hours • Attorney General: 2 hours for CJIS, AFIS, Statewide Booking, Lights out Transaction Control , 1 day for other applications • Health: 2-3 days • Agriculture: 7 days ▪ This is a very high cost solution that overbuilds beyond State business and application requirements.
Active-Hot Standby	2	▪ A **hot standby would be ideal for the State's critical applications**. This has the same benefits as the Warm Standby but allows a faster recovery time. ▪ The primary issue with a hot standby is the cost to implement and maintain it.

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3. Role of Core Data Centers
Qualitative Analysis

Alternative	Rank	Analysis
Active-Warm Standby	1	▪ A **warm standby would be ideal for the State's applications that can be recovered within days** and still meet business requirements. This has the same benefits as the Hot Standby but has a slower recover time. The cost of a warm standby is less than cost of hot standby. ▪ **Ideally the State would use warm standby and hot standby tactically in order to meet the recovery requirements for specific applications.**
Active-Cold Standby	3 **FAIL**	▪ While this is the lowest cost alternative, it **does not meet the State's minimum requirements** for availability and disaster recovery.

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4. Location of Core Data Centers

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4. Location of Core Data Centers
Summary of Analysis

Category	Alternatives
4. Location of Core Data Centers	• Primary- Oahu, Secondary- Oahu • Primary- Oahu, Secondary- Neighbor Island • Primary- Oahu, Secondary- Mainland (co-lo or DR type outsourced service) • Primary- Mainland, Secondary- Mainland

	Alternative 1 Primary-Oahu Secondary-Oahu	Alternative 2 Primary-Oahu Secondary- Neighbor Island	Alternative 3 Primary-Oahu Secondary-Mainland	Alternative 4 Primary-Mainland Secondary-Mainland
Overall Score	326	273	113	83
Ranking	1	2	3	4
Screen	Pass	Pass	Pass	Pass
SUMMARY	Best positions State to successfully operate from secondary DC for extended period in case of disaster. Lowest power costs. Least connectivity risk.	Difficult for State IT staff to travel to/ operate secondary DC for extended period. Highest power costs. Interisland connectivity risk.	Requires outsourcing State DC which is not State strategy. Transpacific connectivity risk. Does not invest in Hawaii. May achieve timeframe for secondary DC only.	Requires outsourcing State DC which is not State strategy. Transpacific connectivity risk. Does not invest in Hawaii. Few/no timeframe benefits.

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4. Location of Core Data Centers – Summary of Analysis

4. Location of Core Data Centers		Alternatives			
Section	Evaluation Criteria	Alt 1 Oahu-Oahu	Alt 2 Oahu-Neighbor Island	Alt 3 Oahu-Mainland	Alt 4 Mainland-Mainland
Cost	Ongoing Total Cost of Ownership				
	Ability to use bonds to fund implementation				
Requirements	Meet disaster recovery requirements & mitigate existing risks				
	Reduce environmental footprint				
	Improve facility availability and reliability				
	Meet data security and protection requirements				
	Meet required application service levels				
	Maximize economic benefit to the State of Hawaii				
	Improve the skills of the State IT workforce				
	Meet the State's long term anticipated capacity needs				
	Ability to adjust capacity to meet changing demand				
	Position the State to leverage new technologies				
	Maximize State control over technology assets				
	Maximize State Department control over services				
	Ability to Support Neighbor Island needs or achieve benefits				
Time	Time to implement new data center				
Risk	Ability to implement new data center(s) on-time/budget				
	Minimize project cost estimate variability				
	Ability of the State to successfully operate/maintain data center				
	Minimize operational disruption (due to migration or failures)				
	Minimize potential for vendor/market disruption				
	Allow predictability and control over long term costs				
	Aligned with best practices or technology trends				
	Minimize potential for one disaster to impact all data centers				
Screening	Meets State's minimum long term anticipated capacity needs	Pass	Pass	Pass	Pass
	Meets State's minimum requirements for availability/disaster recovery	Pass	Pass	Pass	Pass
	Overall Score	326	273	113	83
	Ranking	1	2	3	4
	Screen	Pass	Pass	Pass	Pass

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4. Location of Core Data Centers
Qualitative Analysis

Alternative	Rank	Analysis
Primary-Oahu, Secondary-Oahu	1	▪ The Oahu-Oahu alternative provides the greatest benefits, lowest cost and lowest risk to the State. • Because this approach **does not rely on an interisland or transpacific network connection**, it has less risk of service disruption due to network issues. • Oahu has **the lowest power costs** of the islands, reducing the long term cost of operating the secondary data center when compared to neighbor island locations. Oahu also has at least one existing location that could potentially be retrofitted and used as a secondary data center, leveraging current State investments. • The secondary data center should be 50% - 75% the size and power of the primary data center. For the State, this is a large facility. There **are no existing State or County data centers on the neighbor islands that can serve as an adequate secondary data center** without significant additions to space and power, if those additions are possible at existing locations. • The State should be prepared to operate out of the secondary data center for 12-18 months if the primary data center is incapacitated. This means that State IT staff members need to physically work at the location. Most State IT staff are located on Oahu. **After a severe disaster, it may be difficult to travel between islands** and State staff may need to remain on Oahu to fulfill family/community responsibilities. ▪ If both primary and secondary data centers are on Oahu, they must be geographically separated in order to prevent a single disaster from incapacitating both data centers (e.g., coastal and inland). ▪ While a secondary data center on Oahu does not allow for participation of the neighbor islands specifically in provision of the secondary, there are other ways to incorporate neighbor island stakeholders into the overall footprint of the State's data centers (e.g., satellite data centers at existing facilities).

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4. Location of Core Data Centers
Qualitative Analysis

Alternative	Rank	Analysis
Primary-Oahu, Secondary-Neighbor Island	2	▪ The Oahu-Neighbor Island alternative also provides significant benefits, however the costs and risks are somewhat higher than the Oahu-Oahu alternative. The most critical risks associated with this alternative are: • **Reliance on the interisland network** for connection to the secondary data center: • **Higher power costs** on the neighbor islands when compared to power costs on Oahu. • **Challenges with staff traveling to and remaining on a neighbor island** to operate out of the secondary data center for an extended period after a severe disaster. • **Lack of an existing facility** on neighbor islands that could be used as a secondary data center ▪ Having the secondary data center on a neighbor island **would likely ensure that a single disaster would not impact both the primary and secondary data centers**. ▪ This approach would also ensure participation of/benefits to neighbor island stakeholders. However, the benefits do not outweigh the issues described above.

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4. Location of Core Data Centers
Qualitative Analysis

Alternative	Rank	Analysis
Primary-Oahu, Secondary-Mainland	3	▪ Locating the primary data center on the mainland exposes the State to significant costs and risks with little benefit: • Locating the secondary data center on the mainland would mean outsourcing the State's disaster recovery capabilities. **Substantial outsourcing of operations is not part of the State's overall strategy**. • Outsourcing the secondary data center will be **more costly** than using/improving existing facilities to provide disaster recovery capabilities. • It **does not allow the use of bond funding** and will require significant ongoing operating funds. • There is some **risk of failure and latency associated with the transpacific link** to the mainland. • Because operation of the mainland secondary would be outsourced to a vendor, there **is risk that the vendor will change prices, go out of business or otherwise disrupt operations**. • Does not invest resources in the State. ▪ The only real benefit is that it ensures the primary and secondary data centers will not be impacted by the same disaster. ▪ The State may be able to get the secondary data center operational within the required timeframe, but significant effort would be involved in selecting a vendor.
Primary-Mainland, Secondary-Mainland	4	▪ Locating the primary and secondary data centers on the mainland has all of the costs/risks of the Oahu-Mainland alternative, but those **costs and risks are increased with little increase in benefits**. ▪ This alternative may allow the State to have data center functionality by the end of 2014, but this is not guaranteed. Because this would be a significant outsourcing contract with a high level of potential risk, the RFP and vendor selection process may be lengthy. This may eliminate any gains in implementation time otherwise associated with this alternative.

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5. Procurement – Primary Data Center

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5. Procurement – Primary Data Center
Summary of Analysis

Category	Alternatives
5. Procurement – Primary Data Center	• Existing State land, renovate existing building • Existing State land, build new building • Buy land, build new building • Leverage planned Dept of Education data center facility (cafeteria and other related spaces) with appropriate capacity and redundancy upgrades as Primary • Leverage planned University of Hawaii data center with appropriate capacity and redundancy upgrades as Primary

	Alternative 1 State Land – Renovate State Building	Alternative 2 State Land – New Building	Alternative 3 Buy Land – New Building	Alternative 4 Use DOE Data Center	Alternative 5 Use UH Data Center
Overall Score	276	322	292	224	214
Ranking	3	1	2	4	5
Screen	Pass	Pass	Pass	FAIL	FAIL
SUMMARY	Primary benefit is lower cost and some reduction in timeframe. May not meet the State's requirements as well as a new build due to constraints and build compromises.	Eliminates costs associated with buying land, and allows for a purpose-built data center structure which will best meet the State's requirements.	Gives the State the most flexibility in location and building to meet requirements, but is the highest cost alternative.	Does not meet the State's minimum requirements for long term capacity for a primary data center and is not a viable alternative.	Does not meet the State's minimum requirements for long term capacity for a primary data center and is not a viable alternative.

5. Procurement – Primary Data Center – Summary of Analysis

5. Procurement of Primary Data Center		Alternatives				
Section	Evaluation Criteria	Alt 1 State Land - Renovate State Building	Alt 2 State Land - Build New Building	Alt 3 Buy Land - Build New Building	Alt 4 Use DOE DC	Alt 5 Use UH DC
Cost	Ongoing Total Cost of Ownership					
	Ability to use bonds to fund implementation					
Requirements	Meet disaster recovery requirements & mitigate existing risks					
	Reduce environmental footprint					
	Improve facility availability and reliability					
	Meet data security and protection requirements					
	Meet required application service levels					
	Maximize economic benefit to the State of Hawaii					
	Improve the skills of the State IT workforce					
	Meet the State's long term anticipated capacity needs					
	Ability to adjust capacity to meet changing demand					
	Position the State to leverage new technologies					
	Maximize State control over technology assets					
	Maximize State Department control over services					
	Ability to Support Neighbor Island needs or achieve benefits					
Time	Time to implement new data center					
Risk	Ability to implement new data center(s) on-time/budget					
	Minimize project cost estimate variability					
	Ability of the State to successfully operate/maintain data center					
	Minimize operational disruption (due to migration or failures)					
	Minimize potential for vendor/market disruption					
	Allow predictability and control over long term costs					
	Aligned with best practices or technology trends					
	Minimize potential for one disaster to impact all data centers					
Screening	Meets State's minimum long term anticipated capacity needs	Pass	Pass	Pass	Fail	Fail
	Meets State's minimum requirements for availability/disaster recovery	Pass	Pass	Pass	Pass	Pass
	Overall Score	276	322	292	224	214
	Ranking	3	1	2	4	5
	Screen	Pass	Pass	Pass	FAIL	FAIL

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5. Procurement – Primary Data Center
Qualitative Analysis

Alternative	Rank	Analysis
Existing State land, renovate existing building	3	▪ The **primary benefit of this approach is cost, with some associated reduction in timeframe,** but significant renovations to an existing structure may result in an outcome that does not meet the State's requirements as well as a new build. • In this alternative, the State would use an existing State-owned building and renovate it to create a Tier 3 data center. It is unlikely that the State will find a State building that already meets many of the requirements specific to data center structures (e.g., outside inundation zones or other sources of flooding, hardened, minimal windows, standalone structure, separated parking, setback for perimeter security, etc.). While the State can retrofit an existing building to meet many of these requirements, there will very likely be some requirements that cannot be met due to constraints of the structure or location. This will result in a data center that may meet most of the State's needs, but not as well as a newly built structure. • The State's rule of thumb for retrofitting a building vs. building new is if the retrofit costs 75% or more than the cost of a new building, it is better to build new. Due to the unique nature of a data center structure, and assuming that most existing State buildings have been built for office space, warehouse, or other typical uses, it is likely that the retrofit costs will exceed 75% of the cost of a new build. This depends, of course, on the actual base structure, which is unknown at this time. • If the State were to find a building that is very close to meeting data center requirements, and the retrofit could be done for less than 75% of the cost of a new build with little/no compromise on meeting requirements due to constraints of the existing structure/location, this would be a good option for the State.

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5. Procurement – Primary Data Center
Qualitative Analysis

Alternative	Rank	Analysis
Existing State land, build new building	1	▪ **This alternative leverages existing State land, which eliminates costs and time associated with buying land, and allows for a purpose-built data center structure which will best meet the State's requirements.** • This is more expensive than retrofitting an existing State building, but will result in a structure that is built without constraints/compromises associated with an existing structure or location. This will better meet the State's key requirements underlying the entire effort, including better availability, resiliency, disaster recovery, ability to meet long term capacity, etc. ▪ The timeframe for this may be slightly longer than the time for retrofitting if we base the timeframe estimate on the State's rule of thumb that $1M-$2M in construction value = 1 month of construction time. However, a large retrofit project could encounter issues/obstacles that extend the expected timeframe.
Buy land, build new building	2	▪ **This alternative gives the State the most flexibility in location and building to meet requirements, but is the highest cost alternative.** • In choosing a new location, the State may gain additional benefits that current State properties do not have (e.g., access to two power sources). ▪ The timeframe for this may be longer than using existing State land as the site selection process could take longer and time required to negotiate with the seller. If the State were to purchase land in a specific-use area, such as a Technology Park, there may be less time required than purchasing land from an individual seller.

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5. Procurement – Primary Data Center
Qualitative Analysis

Alternative	Rank	Analysis
Leverage planned Dept of Education data center facility	FAIL	▪ The Department of Education (DOE) is retrofitting a decommissioned school as a data center to serve the needs of the Department. DOE plans to have the first phase of the data center operational by December 2013. DOE plans to use a container approach to create 1000 sq. ft. of server room space with adequate cooling to support up to 500kw of IT equipment. DOE expects to fill that space within 5 years. ▪ **This space does not meet the State's minimum requirements for long term capacity for a primary data center and is not a viable alternative.**

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5. Procurement – Primary Data Center
Qualitative Analysis

Alternative	Rank	Analysis
Leverage planned University of Hawaii data center	FAIL	▪ The University of Hawaii is completing construction on a new 74,000 sq. ft. building on the Manoa campus. This building includes an 8,000 sq. ft. data center that will be used to consolidate University servers. The entire second floor of the six story building is devoted to Data Center Operations. Floor 1 contains the Help Desk, a Digital Media Center for faculty use, a training room, and two video conferencing rooms. Floors 3-6 are office space for IT staff. ▪ The data center will be operational by Fall 2013. UH will fill a substantial portion of the space upon move in. The remaining space is slated for growth in University resources. ▪ **This space does not meet the State's minimum requirements for long term capacity for a primary data center and is not a viable alternative.** • The remaining space is only temporarily available as UH plans to fill that space as need arises. • There is no ability to increase the size of the space in the short term as building construction is nearing completion. The other floors in the building will be occupied by other University uses and are not available or built for data center space. ▪ This space could be used by the State temporarily to house applications as needed, but the State and the University would need a clear agreement and guarantees about the duration of the State's use. This approach results in additional migration risk.

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5. Procurement – Primary Data Center Land Requirements

- Approximately 80,000 square feet – 100,000 square feet (2-3 acres) of usable land
- Outside the tsunami inundation zone
- Not subject to flooding from rainfall / runoff / leaks
- Adequate site for at-grade development (parking, water storage, fuel storage, generators, other)
- Truck access
- Adequate power: 1.5 MW – 2 MW of IT equipment load
- Access to power
  - From a single source – Minimum Requirement
  - From diverse sources (multiple grids, other) – Preferred
- Access to telecommunications services
  - From a single source – Minimum Requirement
  - Access to telecommunications services from diverse sources (multiple entrances, access providers, fiber paths, other) – Preferred
- Away from sources of vibration and high-risk sources, such as airports, rail lines
- Local authorities amenable to use of land for a data center facility (appropriate zoning, no adverse impacts on local traffic patterns)
- Away from residential or other sound-sensitive uses
- Away from neighboring structures to allow for proper storage (if possible fenced off from neighboring properties)
- Within one hour commute from major population centers

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5. Procurement – Primary Data Center Structure Requirements

- Approximately 20,000 square foot – 25,000 square foot structure
- Standalone structure
- One-story structure (preferred), or two-story structure
- Parking away from the building
- Windowless structure (preferred), or minimal windows/other openings in the walls
- Hardened facility
- Level roof without skylights
- Sufficient setback of building for perimeter security purposes
- Single point of entry for people
- Dedicated loading docks for equipment delivery access
- Large floor plates (as in industrial buildings)
- Large column bays (30’x50’ is ideal)
- Minimum 13'-6" clear from structural slab to lowest structural member

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5. Procurement – Primary Data Center
Procurement Timeframes

- Estimated timeframe for constructing the Primary Data Center using the State's typical process is a total of 50 months.

Phases and Tasks	FY14				FY15				FY16				FY17				FY18			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Build New Tier 3 State Data Center																				
Planning																				
Project Start Up (3)																				
Project Planning/Project Dev. Report (3)																				
Site Selection/Feasiblity Assesment (3)																				
Environment Impact/EA FONSI (3)																				
Land Acquistion (3)																				
Title Transfer/Master Planning (6)																				
Design																				
Design Firm Bidding Process (3)																				
Data Center Facility Design (15)																				
Construction Bidding Process (3)																				
Build/Outfitting																				
Building Permits (6)																				
Construction (12)																				
Commissioning (2)																				
Furniture and Fixtures/Outfitting (3)																				
IT Equiptment Implementaiton (3)																				

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6. Procurement – Secondary Data Center

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6. Procurement – Secondary Data Center Introduction

Category	Alternatives
6. Procurement – Secondary Data Center	• Leverage existing ICSD Data center with appropriate upgrades/changes • Leverage planned Dept of Education DC facility, if not used as primary • Leverage planned Univ of Hawaii DC facility, if not used as primary • Use Commercial Co-location Facility • Build new in existing available State office space

	Alternative 1 Use ICSD Data Center	Alternative 2 Use DOE Data Center	Alternative 3 Use UH Data Center	Alternative 4 Use Commercial Co-Location Facility	Alternative 5 Build New in Existing State Office Space
Overall Score	322	224	214	245	263
Ranking	1	4	5	3	2
Screen	Pass	FAIL	FAIL	Pass	Pass
SUMMARY	Immediately available, leverages existing resources, lowest cost alternative, no vendor risk, State control over resources. Some issues with location cannot be resolved.	Does not meet State's minimum requirements for long term capacity for a secondary data center. Not a viable alternative.	Does not meet State's minimum requirements for long term capacity for a secondary data center. Not a viable alternative.	Short time to implement and meets availability and DR needs. Cannot be funded using bonds and reduces State control over resources.	Eliminates vendor risks associated with co-location and gives State control over resources/services. Longest time to implement and more costs and risks than improving/using ICSD.

Engagement: [illegible]
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6. Procurement – Secondary Data Center – Summary of Analysis

6. Procurement of Secondary Data Center		Alternatives				
Section	Evaluation Criteria	Alt 1 ICSD DC	Alt 2 DOE DC	Alt 3 UH DC	Alt 4 Co-location Vendor	Alt 5 State building, New DC
Cost	Ongoing Total Cost of Ownership					
	Ability to use bonds to fund implementation					
Requirements	Meet disaster recovery requirements & mitigate existing risks					
	Reduce environmental footprint					
	Improve facility availability and reliability					
	Meet data security and protection requirements					
	Meet required application service levels					
	Maximize economic benefit to the State of Hawaii					
	Improve the skills of the State IT workforce					
	Meet the State's long term anticipated capacity needs					
	Ability to adjust capacity to meet changing demand					
	Position the State to leverage new technologies					
	Maximize State control over technology assets					
	Maximize State Department control over services					
	Ability to Support Neighbor Island needs or achieve benefits					
Time	Time to implement new data center					
Risk	Ability to implement new data center(s) on-time/budget					
	Minimize project cost estimate variability					
	Ability of the State to successfully operate/maintain data center					
	Minimize operational disruption (due to migration or failures)					
	Minimize potential for vendor/market disruption					
	Allow predictability and control over long term costs					
	Aligned with best practices or technology trends					
	Minimize potential for one disaster to impact all data centers					
Screening	Meets State's minimum long term anticipated capacity needs	Pass	Pass	Pass	Pass	Pass
	Meets State's minimum requirements for availability/disaster recovery	Pass	Fail	Fail	Pass	Pass
	Overall Score	322	224	214	245	263
	Ranking	1	4	5	3	2
	Screen	Pass	FAIL	FAIL	Pass	Pass

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6. Procurement – Secondary Data Center
Qualitative Analysis

Alternative	Rank	Analysis
Leverage existing ICSD Data center with appropriate upgrades/changes	1	▪ Making improvements to the ICSD Data Center in the Kalanimoku Building leverages the State's existing investment in infrastructure and would make a suitable secondary data center for long term operations if the State's primary data center becomes incapacitated. • Although investment will be required to improve the facility, this is the lowest cost alternative. • Staff is familiar with the data center and would be successful in operating it as a disaster recovery site. • Time to implement is very short considering State resources are already there and it can be used immediately as a secondary site. Making improvements will take additional time but does not prevent the site from being used. ▪ Some characteristics of the ICSD Data Center cannot be corrected. • The data center is below grade in the basement of the building and is subject to flooding from natural causes and from leaks in the building above. • Perimeter security cannot be improved as Kalanimoku is a public office building. • The Kalanimoku building is not within the tsunami inundation zone, but it is close to the edge of the zone. Given Kalanimoku's coastal location, the best placement for the primary data center would be inland, well away from the coast. ▪ The ICSD Data Center would need the following improvements in order to be a suitable secondary data center site and meet the State's requirements for availability and disaster recovery: • Modernize power • Replace commercial air handlers with computer room air handlers • Reconfigure the space so people, printing and computer room are separate • Refurbish cooling system pipe insulation

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6. Procurement – Secondary Data Center Qualitative Analysis

Alternative	Rank	Analysis
Leverage planned Dept of Education DC facility	FAIL	▪ **This space does not meet the State's minimum requirements for long term capacity for a secondary data center and is not a viable alternative.**
Leverage planned Univ of Hawaii DC facility	FAIL	▪ **This space does not meet the State's minimum requirements for long term capacity for a secondary data center and is not a viable alternative.** • This space could be used by the State temporarily to house applications as needed, but the State and the University would need a clear agreement and guarantees about the duration of the State's use. This approach results in additional migration risk.
Use Commercial Co-location Facility	3	▪ This alternative **meets the State's availability and disaster recovery needs but has vendor-related risks and cannot be funded using bonds.** • The State does not have control over technology resources or services, and is subject to vendor risks and costs (e.g., going out of business, increasing prices, etc.) • It cannot be funded using bonds, and requires long term operating budget which is difficult to secure in the State. • Introduces migration risk when compared to keeping resources at ICSD data center.

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6. Procurement – Secondary Data Center
Qualitative Analysis

Alternative	Rank	Analysis
Build new in existing available State office space	2	▪ This approach **entails more costs and risks than making improvements and using the ICSD data center, but it avoids the vendor risks associated with co-location.** • This is the highest cost option as it involves significant retrofitting of existing space. • Longest timeframe for getting the secondary data center operational; Site Selection Study and Site Feasibility Study would be required, adding significant time to the process when compared to other alternatives. • Introduces migration risk when compared to keeping resources at ICSD data center. ▪ Primary benefits of this approach are that it gives the State control over technology assets and services, and allows the use of bond funding.

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6. Procurement – Secondary Data Center Assumptions and Requirements

- Assumptions
  - Virtually all application data must be replicated, with a Recovery Point Objective (RPO) equal to or close to zero
  - Enterprise applications (e.g., ERP) must be recoverable in 72 hours
  - There are a small number of applications which require little to no downtime (e.g., civil defense, criminal justice, lands and natural resources, public assistance, child protective services, etc.)
  - The majority of critical applications, with exceptions of those on the mainframe, are assumed to be virtualized and use shared SAN storage
- Secondary Data Center Requirements
  - A Tier 2 disaster recovery facility is in line with common practice across government and commercial sectors.
  - Space Requirements
    - 60% - 80% the size of the primary data center. With a primary data center of approximately 7800 sq. ft., the secondary data center should be 4500 – 6000 sq. ft.
  - Power Requirements
    - 60% - 80% the power of the primary data center. With a primary data center of approximately 1.6MW, the secondary data center will draw approximately 900KW – 1.3MW
  - Land and Structure Requirements
    - The requirements for the secondary data center are the same as for the primary (except for space and power requirements defined above).

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7. Data Center Facility Architecture

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7. Data Center Facility Architecture
Summary of Analysis

Category	Alternatives
7. Data Center Facility Architecture	• Traditional • Modular • Container-Based

	Alternative 1 Traditional	Alternative 2 Modular	Alternative 3 Container-Based
Overall Score	271	342	336
Ranking	3	1	2
Screen	Pass	Pass	Pass
SUMMARY	May result in overbuilding, requires significant capital investment up front for space that may not ultimately be used. Requires integration between products and vendors.	Build as you go could result in overall lower total cost of ownership when compared to traditional, provides flexibility for the State to take advantage of new data center spaces or opportunities to partner.	Has the benefits of modular building with added benefit of highly efficient power and cooling, reducing total cost of ownership. Has vendor associated risks and is not yet leading practice.

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7. Data Center Facility Architecture – Summary of Analysis

7. Data Center Facility Architecture		Alternatives		
		Alt 1 Traditional	Alt 2 Modular	Alt 3 Container-based
Section	**Evaluation Criteria**			
Cost	Ongoing Total Cost of Ownership			
	Ability to use bonds to fund implementation			
Requirements	Meet disaster recovery requirements & mitigate existing risks			
	Reduce environmental footprint			
	Improve facility availability and reliability			
	Meet data security and protection requirements			
	Meet required application service levels			
	Maximize economic benefit to the State of Hawaii			
	Improve the skills of the State IT workforce			
	Meet the State's long term anticipated capacity needs			
	Ability to adjust capacity to meet changing demand			
	Position the State to leverage new technologies			
	Maximize State control over technology assets			
	Maximize State Department control over services			
	Ability to Support Neighbor Island needs or achieve benefits			
Time	Time to implement new data center			
Risk	Ability to implement new data center(s) on-time/budget			
	Minimize project cost estimate variability			
	Ability of the State to successfully operate/maintain data center			
	Minimize operational disruption (due to migration or failures)			
	Minimize potential for vendor/market disruption			
	Allow predictability and control over long term costs			
	Aligned with best practices or technology trends			
	Minimize potential for one disaster to impact all data centers			
Screening	Meets State's minimum long term anticipated capacity needs	Pass	Pass	Pass
	Meets State's minimum requirements for availability/disaster recovery	Pass	Pass	Pass
	Overall Score	271	342	336
	Ranking	3	1	2
	Screen	Pass	Pass	Pass

Engagement: **330011782**

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7. Data Center Facility Architecture Qualitative Analysis

Alternative	Rank	Analysis
Traditional	3	▪ This alternative entails building and outfitting the data center facility for the State's long term needs. ▪ **This may result in overbuilding and requires significant capital investment up front for space that may not ultimately be used.** ▪ This requires integration between multiple products and vendors if a best-of-breed approach is used.
Modular	1	▪ This allows the State to build the overall structure initially, but bring in power, cooling and outfitting as needed based on the State's expanding requirements. ▪ This **allows the State to "build-as-you-go" as capacity needs change.** • Could result in overall lower total cost of ownership when compared to traditional as increased virtualization may reduce the need for planned space. • Provides flexibility for the State and allows it to take advantage of new data center spaces or opportunities to partner with other agencies that they become available over time. • Allows for the use of new technologies in future modular build-outs.
Container Based	2	▪ This alternative entails using pre-fabricated containers with integrated racks, power and cooling to house servers. Additional containers would be purchased as the State's needs change over time. ▪ This **allows the State to add capacity as needs change, but has vendor-related risks and is not common practice** • Containers provide highly efficient power and cooling, which lowers operating costs over time. • This also allows the State to build in a modular approach, but by using efficient containers instead of traditional building. • Reduces need for integration since the containers are already integrated. ▪ There is vendor-related risk associated with this alternative as the State is dependent on the container vendor. ▪ This is not yet leading practice

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8. Neighbor Island Participation

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8. Neighbor Island Participation Introduction

Category	Alternatives
8. Neighbor Island Participation	• Improve/Expand Existing State Department Server Closets on Neighbor Islands • Build State Controlled and Security "Caged" Environments within Existing or Planned County Data Centers • Build State Data Centers on each Neighboring Island

	Alternative 1 Improve/Expand Existing State Dept Server Closets on Neighbor Islands	Alternative 2 Build State Controlled Caged Environments in Existing/Planned County Data Centers	Alternative 3 Build State Data Centers on Neighbor Islands
Overall Score	316	316	256
Ranking	1	1	3
Screen	Pass	Pass	Pass
SUMMARY	Leverages existing State investments, could reduce timeframe, State maintains control over technology resources. More expensive than using County space. Potentially feasible on Maui and Kauai. Additional review required.	Leverages modern County facilities. Best option for Hawaii Island. Reduces State control over resources, may have increased timeframe as new Maui facility is in early planning stages.	Gives the State the most control over resources. Highest cost and will take the longest to achieve.

8. Neighbor Island Participation – Summary of Analysis

8. Neighbor Island Participation		Alternatives		
Section	Evaluation Criteria	Alt 1 Improve / Expand State Dept Server Closets	Alt 2 Build State Controlled Environments in County DCs	Alt 3 Build State Data Centers
Cost	Ongoing Total Cost of Ownership			
	Ability to use bonds to fund implementation			
Requirements	Meet disaster recovery requirements & mitigate existing risks			
	Reduce environmental footprint			
	Improve facility availability and reliability			
	Meet data security and protection requirements			
	Meet required application service levels			
	Maximize economic benefit to the State of Hawaii			
	Improve the skills of the State IT workforce			
	Meet the State's long term anticipated capacity needs			
	Ability to adjust capacity to meet changing demand			
	Position the State to leverage new technologies			
	Maximize State control over technology assets			
	Maximize State Department control over services			
	Ability to Support Neighbor Island needs or achieve benefits			
Time	Time to implement new data center			
Risk	Ability to implement new data center(s) on-time/budget			
	Minimize project cost estimate variability			
	Ability of the State to successfully operate/maintain data center			
	Minimize operational disruption (due to migration or failures)			
	Minimize potential for vendor/market disruption			
	Allow predictability and control over long term costs			
	Aligned with best practices or technology trends			
	Minimize potential for one disaster to impact all data centers			
Screening	Meets State's minimum long term anticipated capacity needs	Pass	Pass	Pass
	Meets State's minimum requirements for availability/disaster recovery	Pass	Pass	Pass
	Overall Score	316	316	256
	Ranking	1	1	3
	Screen	Pass	Pass	Pass

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8. Neighbor Island Participation
Qualitative Analysis

Alternative	Rank	Analysis
Improve/ Expand Existing State Department Server Closets on Neighbor Islands	1	▪ This alternative entails expanding and improving space within an existing State Office Building to create a secure server room area. We scored this alternative assuming that the State Office Buildings are in suitable locations. We then conducted additional analysis to determine if that is, in fact, true for each location. ▪ This alternative allows the State **to leverage existing locations that are already connected to the State network and within State control**. • This could reduce the time required to make the improvements since agreements with outside agencies are not required. • The State maintains control over technology resources. ▪ This is likely **more expensive than using County Data Center space** because significant investment in cooling and power will likely be required for the renovated space. It should be less expensive than building new data centers as the existing building shell will be leveraged. ▪ This alternative is **only feasible on Maui and Kauai.** The State Office Building on Hawaii Island is within the Tsunami Evacuation Zone and should not be considered a site for a Satellite Data Center. ▪ **Additional review is required** to determine if the State Office Buildings on Maui and Kauai have, or could be improved to have, adequate space, power and cooling.

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8. Neighbor Island Participation
Qualitative Analysis

Alternative	Rank	Analysis
Build State Controlled and Security "Caged" Environments within Existing or Planned County Data Centers	1	▪ This alternative entails building out secure space within existing or planned County data centers. The County of Maui is in the early planning stages of a new Data Center/Emergency Operations Center. The County of Hawaii is moving to a new data center opened in 2011. ▪ This alternative **leverages existing County data center facilities built to withstand hurricane force wind, and outfitted with cooling, power and security.** ▪ This is the **best option for Hawaii Island** as there is an existing County location and the State Office Building is not suitable. ▪ The alternative has some drawbacks: • Requires coordination with partner agencies which **may take additional time and results in the State giving up some control over resources**. • The **Maui facility is in early planning stages** so it is unclear when it would be ready for State use. This does, however, allow the State to participate early in the planning process to help ensure State needs are met. ▪ **Additional review is required** to determine existence of facilities and opportunities for partnering with Kauai. County of Kauai was unable to participate during the period of this study.
Build State Data Centers on each Neighboring Island	2	▪ This alternative gives the State the **most control over resources, but is also the highest cost and will take the longest to achieve**. • Given the current/planned availability of County facilities and the potential to renovate existing State space, this alternative has the highest cost with little increase in benefits.

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9. Primary Data Center Tier

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9. Primary Data Center Tier
Summary of Analysis

Category	Alternatives
9. Primary Data Center Tier	• Tier 1 • Tier 2 • Tier 3 • Tier 4

	Alternative 1 Tier 1	Alternative 2 Tier 2	Alternative 3 Tier 3	Alternative 4 Tier 4
Overall Score	233	279	314	276
Ranking	4	2	1	3
Screen	Fail	Pass	Pass	Pass
SUMMARY	Does not meet State's minimum requirements for availability and disaster recovery. Not a viable alternative.	22 hours of expected annual downtime does not meet availability needs for critical applications; not sufficient for State's primary data center. Could be sufficient for a secondary data center if the primary is Tier 3 or 4.	1.6 hours of expected annual downtime fully meets the State's availability needs for critical applications without overbuilding.	Provides the highest level of availability with .4 hours expected annual downtime. Highest cost and overbuilds for the State's requirements.

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9. Primary Data Center Tier – Summary of Analysis

9. Primary Data Center Tier		Alternatives			
Section	Evaluation Criteria	Alt 1 Tier 1 Data Center	Alt 2 Tier 2 Data Center	Alt 3 Tier 3 Data Center	Alt 4 Tier 4 Data Center
Cost	Ongoing Total Cost of Ownership				
	Ability to use bonds to fund implementation				
Requirements	Meet disaster recovery requirements & mitigate existing risks				
	Reduce environmental footprint				
	Improve facility availability and reliability				
	Meet data security and protection requirements				
	Meet required application service levels				
	Maximize economic benefit to the State of Hawaii				
	Improve the skills of the State IT workforce				
	Meet the State's long term anticipated capacity needs				
	Ability to adjust capacity to meet changing demand				
	Position the State to leverage new technologies				
	Maximize State control over technology assets				
	Maximize State Department control over services				
	Ability to Support Neighbor Island needs or achieve benefits				
Time	Time to implement new data center				
Risk	Ability to implement new data center(s) on-time/budget				
	Minimize project cost estimate variability				
	Ability of the State to successfully operate/maintain data center				
	Minimize operational disruption (due to migration or failures)				
	Minimize potential for vendor/market disruption				
	Allow predictability and control over long term costs				
	Aligned with best practices or technology trends				
	Minimize potential for one disaster to impact all data centers				
Screening	Meets State's minimum long term anticipated capacity needs	Pass	Pass	Pass	Pass
	Meets State's minimum requirements for availability/disaster recovery	Fail	Pass	Pass	Pass
	Overall Score	233	279	314	276
	Ranking	4	2	1	3
	Screen	Fail	Pass	Pass	Pass

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9. Primary Data Center Tier Qualitative Analysis

Alternative	Rank	Analysis
Tier 1	FAIL	▪ While this is the lowest cost alternative, it does not meet the State's minimum requirements availability and disaster recovery. Not a viable alternative. Some issues associated with this alternative are: • Numerous single points of failure • No generator, UPS has 8-15 minutes of backup time • Extremely vulnerable to inclement weather conditions • Generally unable to sustain more than a 10 minute power outage • 40+ hours of expected downtime per year ▪ The State has several critical applications that require little/no downtime, and a Tier 1 data center does not meet that requirement.
Tier 2	2	▪ This does not meet the State's requirements for a primary data center in order to provide little/no downtime for critical applications. Beneficial features of this alternative are: • Some redundancy in power and cooling systems • Generator backup; Fire suppression system • Able to sustain 24 hour power outage • Vapor barrier for humidity and air quality control • Formal data room separate from other areas ▪ Some issues associated with this alternative are: • Minimal thought to site selection • 22 hours of expected downtime per year ▪ The State has several critical applications that require little/no downtime, and a Tier 2 data center does not meet that requirement. ▪ This alternative is lower cost than Tier 3 and Tier 4, and provides better availability than Tier 1. A Tier 2 data center would likely be sufficient as a secondary data center, assuming the primary is a Tier 3 or 4.

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9. Primary Data Center Tier Qualitative Analysis

Alternative	Rank	Analysis
Tier 3	1	▪ This alternative meets the State's requirements for availability and disaster recovery without overbuilding. Beneficial features of this alternative are: • Two utility paths (active and passive) • Redundant power and cooling systems • Redundant service providers • Able to sustain 72-96 hour power outage • Appropriate site; Purpose built facility • 7x24x365 Security and Operational Staffing • Fire suppression system; One-hour fire rating • Allows for concurrent maintenance • 1.6 hours per year of expected downtime ▪ The 1.6 hours of expected downtime with a Tier 3 data center should meet the availability requirements of the State's most critical applications.
Tier 4	3	▪ While this alternative provides the highest level of availability, it is also the highest cost and overbuilds for the State's requirements. The very robust design of this alternative includes: • Two independent utility paths • 2N power and cooling systems • Able to sustain indefinite power outage • Stringent site selection/facility design • Fire suppression system ; 2-4 hour fire rating • 7x24x365 Security and Operational Staffing • .4 hours per year of expected downtime ▪ The cost of this alternative is significantly higher than the others, and is not warranted given that this level of robustness is not needed to meet the State's requirements.

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Appendix C: Acronyms

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Acronyms

- CapEx: Capital Expenditure
- COOP: Continuity of Operations Plan
- CIP: Capital Improvement Project
- CSOC: Cyber Security Operations Center
- DC: Data Center
- DOD: Department of Defense
- DR: Disaster Recovery
- EOC: Emergency Operations Center
- ERP: Enterprise Resource Planning
- FDCCI: Federal Data Center Consolidation Initiative
- FTE: Full Time Equivalent
- FY: Fiscal Year
- GDP: Gross Domestic Product
- IaaS: Infrastructure as a Service
- IT: Information Technology
- MOU: Memorandum of Understanding
- NI: Neighbor Island
- NOC: Network Operations Center
- NPV: Net Present Value
- OpEx: Operating Expenditure
- PaaS: Platform as a Service
- PMO: Project Management Office
- RTO: Recovery Time Objective
- SaaS: Software as a Service
- SC: Services Center
- SSC: Shared Service Center
- UH: University of Hawaii
- UPS: Uninterruptible Power Supply

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Acronyms (continued)

State Department and Agency Acronyms

Acronym	Department	Acronym	Department
ATG	Attorney General's Office	DOD	Department of Defense
B&F	Budget and Finance	DOE	Department of Education
DAGS	Department of Accounting and General Services	DOH	Department of Health
DBEDT	Department of Business Economic Development and Tourism	DOT	Department of Transportation
DCCA	Department of Commerce and Consumer Affairs	DOTAX	Department of Taxation and Revenue
DHHL	Department of Hawaiian Homelands	HDOA	Agriculture Department
DHRD	Department of Human Resources & Development	HSPLS	Hawaii State Public Library System
DHS	Department of Human Services	ICSD	Information and Communication Services Division
DLIR	Department of Labor Industrial Relations	PSD	Public Safety Department
DLNR	Department of Land and Natural Resources		

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